EEA operational guidelines

Guide to geographical data and maps

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Project manager: Chris Steenmans

Foreword

The EEA is mandated by its regulation to provide high quality information to support the environmental policy process and sustainable development, and for the assessment of environmental achievements and outcomes. In this context, the EEA will provide more and better quality geographical information. Common routines and standardised processes are essential to obtain input data of acceptable quality in order to undertake quality assessments.

The aim of these guidelines is to provide guidance on spatial data handling to all GIS users who deliver material to EEA products: internally at the EEA, at European topic centres (ETCs), or other partners. There is a need to strengthen the harmonisation of spatial data handling by different topic areas and to ensure improved quality control on spatial data and derived products, e.g. maps.

These guidelines and accompanying EEA map data and EEA map templates were presented as draft versions at the Data Managers Workshop in June 2002, and have now been used by the EEA and several of the ETCs since summer 2002. The experience gained since the draft versions were introduced has led to the creation of this version 1.0 of the EEA guide for geographical data and maps (pending final approval of the EEA Senior Management Team)

The guidelines are linked as far as possible to standardisation agreements within the European Commission and also to the initial work developed by Inspire – Infrastructure for spatial information in Europe (http://www.ec-gis.org/inspire).

Data handling and information services are under rapid development. This affects the development of guidelines. It is expected that the development of different tools and information products will influence the recommendations for data handling and map productions, and thus that the guidelines too will need revision from time to time. Users of the guidelines will find updated information at the EEA website: http://www.eionet.eu.int/gis.

Any comments and questions can be forwarded using the web interface at http://www.eea.eu.int/help/infocentre/enquiries.

Contents

1. OVERVIEW OF TOPICS 6

1.1. OVERVIEW OF TOPICS BY CHAPTER 6

2. COORDINATE REFERENCE SYSTEMS AND PROJECTIONS 7

2.1. BACKGROUND AND FOCUS 7
2.2. EUROPEAN INITIATIVE AND RECOMMENDATIONS 7
2.3. EEA GENERAL GUIDELINES ON COORDINATE REFERENCE SYSTEMS 8
2.4. EEA RECOMMENDATIONS: SPECIFIC PROJECTIONS FOR DIFFERENT PURPOSES AND PRODUCTS 9
2.5. AVAILABLE DOCUMENTS AND FILES FOR WORKING WITH PROJECTIONS 11

3. WORKING WITH POINT LOCATIONS: LATITUDE/LONGITUDE 12

3.1. BACKGROUND 12
3.2. FORMATTING LATITUDE/LONGITUDE COORDINATES 12
3.3. CONVERSION FROM DMS FORMAT TO DD FORMAT 12

4. GIS DATA DELIVERY: VECTOR AND RASTER FORMATS 14

4.1. QUALITY AND QUALITY CONTROL 14
4.2. PROJECTION AND SCALE 14
4.3. RESOLUTION AND GENERALISATION 15
4.4. GEOMETRIC QUALITY REPRESENTATION AND TOPOLOGY 15
4.5. THEMATIC QUALITY 16
4.6. NAMING OF FILES AND ATTRIBUTES 16
4.7. RECOMMENDED FORMATS FOR GEOGRAPHICAL DATASETS 16

5. WORKING WITH GRIDS 20

5.1. INTRODUCTION 20
5.2. EXAMPLES OF GRIDS USED IN ENVIRONMENTAL MAPPING 20
5.3. TYPES OF REFERENCE GRIDS 20
5.4. RECOMMENDATIONS FOR SELECTING OR DEFINING A GRID 23

6. MAP EXTENTS USED BY THE EEA 27

6.1. MAP EXTENTS: NORTH, SOUTH, EAST, WEST 27
6.2. RECOMMENDED MAP EXTENTS: A FULL SERIES 27
6.3. MAP EXTENTS: ILLUSTRATIONS OF EEA MAP EXTENT SERIES 28
6.4. SPECIFICATION OF MAP EXTENTS BY COORDINATES 35

7. EEA MAP LAYOUT AND POSTSCRIPT MAP TEMPLATES FOR REPORTS 36

7.1. STANDARD SIZE FOR POSTSCRIPT MAPS 36
7.2. STANDARD MAP PROJECTIONS 37
7.3. MAP EXTENTS FOR POSTSCRIPT MAPS AND OTHER FINAL VERSION MAPS 37
7.4. SCALES OF POSTSCRIPT MAPS 37
7.5. LEVEL OF GENERALISATION 37
7.6. STANDARD ELEMENTS/FEATURES IN MAPS 38
7.7. STANDARD LAYER ORDERS 39
7.8. COLOUR AND GRAPHICS DEFINITIONS 40
7.9. LEGEND 42

7.10. TEXT: TRANSLATION IMPLICATIONS 42
7.11. MAP TEMPLATES IN ARCGIS 43
7.12. MAP TEMPLATES IN ADOBE ILLUSTRATOR FORMAT 43

8. EEA MAP TEMPLATES FOR GIS: TOOLS FOR EASY MAP MAKING 44

8.1. WHY USE A PREDEFINED MAP TEMPLATE? 44
8.2. AVAILABLE GIS TEMPLATE FILES 44
8.3. ARCGIS TEMPLATE FILES AND USING OTHER SOFTWARE 44
8.4. STANDARD MAP DATA FOR MAP TEMPLATES 45
8.5. QUICK GUIDE TO USING ARCGIS MXT TEMPLATE FILES 46
8.6. PREDEFINED MAP EXTENTS AND STANDARD MAP DATA FOR ARCVIEW 3.X AND OTHER SOFTWARE 47

9. METADATA FOR GEOGRAPHICAL DATA AND MAPS 48

9.1. REQUIREMENTS ON GIS AND MAP DELIVERABLES 48
9.2. EEA STANDARD FOR METADATA 48
9.3. DIFFERENT METADATA REQUIREMENTS FOR DIFFERENT KINDS OF GEODATA 48
9.4. USING EEA METADATA EDITOR FOR ARCCATALOG 49
9.5. USING EEA SPATIAL DATA METADATA INFORMATION FORM 54
9.6. USING EEA METADATA FORM FOR MAPS 55

1. Overview of topics

Since 2001, the EEA has worked on developing guidelines and tools with the aims of:

- standardising the handling of geographical data by considering the following aspects:
    - projections
    - accuracy
    - formats
    - data structure
    - quality control routines;
- standardising maps for printed reports and Web applications in terms of:
    - map extents
    - colours
    - creating generalised data and template files for use with ArcGIS
    - creating ready-to-use maps for use with Adobe Illustrator;
- developing Web services;
- developing standards and tools for metadata handling;
- improving quality of information delivered to and used by EEA.

1.1. Overview of topics by chapter

The table is a quick guide to which chapters contain information on the listed topics.

Topic	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7	Ch. 8	Ch. 9
Datum	X	X						
EEA map data							X	
Geodatabases			X					
GIS map templates							X	
Grids				X				
Latitude/longitude	X	X						
Map extents					X			
Map layout standards						X		
Metadata on data								X
Metadata on maps								X
Postscript maps						X		
Projection	X							
Raster data			X					
Vector data			X					

2. Coordinate reference systems and projections

2.1. Background and focus

This chapter describes the EEA standardisation of coordinate reference systems and projections for the storage and treatment of geographical databases and map display. This is a follow-up to the European Commission decisions from 2003 to use specific coordinate reference systems and projections. Producers and users of spatial data and maps should be aware that different assessment operations require different projections, and that maps should have a projection defined by the EEA. Using defined standards has made it possible to develop templates and efficient tools for data handling, and will reduce the burden of documentation both for the EEA and its cooperating partners.

There are several reasons why the EEA finds it necessary to develop specifications in this field.

- The lack of documentation and skills in the field of transformations and projections causes frustrations, inefficient handling of geographical data, inaccurate data and analysis results.
- A variety of different projections are being used among the EEA, ETCs and national institutions, while documentation is limited.
- ETCs and other European projects experience severe problems when combining data from different countries. The EEA is cooperating with more than 30 countries. In order to streamline the data flow, standardisation is needed in the field of coordinate reference systems and projections.
- It is foreseen that the EEA will use spatial assessments more actively in the coming years, making it important to follow guiding principles for the best possible use of the data available.

2.2. European initiative and recommendations

The experiences linked to EEA activities are typical for other agencies working with many partners and with partners covering large areas. This resulted in an initiative from the European Commission. The aim has been to develop pan-European standards for coordinate reference systems and recommended projections, to be applied by national mapping agencies, the European Commission and other agencies treating geographical information.

The work was carried out by an expert group of the cartographic projections workshop. The EEA participated alongside other experts from national mapping agencies, the Joint Research Centre, Eurostat/GISCO, Eurogeographics and others. Their recommendations were released in November 2001, and were approved by COGI (Commission Inter Service Group on Geographical Information) in 2003 for use within the Commission services. Through working groups, Inspire – Infrastructure for spatial information in Europe (http://www.ec-gis.org/inspire) – has recommended their use to a wider user community.

2.3. EEA general guidelines on coordinate reference systems

The recommendations by the European Commission and the wider European initiatives should be followed as far as possible by the EEA.

2.3.1. A common European spatial reference system – ETRS89 and EVRS

Different workshops and expert group contributions prepared the ground for the definition of the common European spatial reference system and its use for geo-referencing of the data of the European Commission. The definition will be used in future specifications of products to be delivered to the Commission within projects, contracts, etc, and for the promotion of wider use within all Member States.

The European Terrestrial Reference System 1989 (ETRS89) and the European Vertical Reference System (EVRS) form together the European Spatial Reference System as an integrated reference.

The name of the coordinate reference system is ETRS89**.** The European terrestrial reference system 1989 (ETRS89) is the geodetic datum for pan-European spatial data collection, storage and analysis. It is based on the GRS80 ellipsoid and is the basis for a coordinate reference system using ellipsoidal coordinates. The ETRS89 ellipsoidal coordinate reference system is recommended to express and to store positions.

In Europe, about 20 different physical height systems are used based on different tide gauges, resulting in inconsistencies within a two metre range. Data exchange related to altitude between different countries and communities in Europe should be handled carefully. For referencing height, the European vertical reference system (EVRS) is proposed for adoption by the European Commission to promote widespread use as a standard for future pan-European data products. EVRS includes a European Vertical Datum and the European Vertical Reference Frame (EVRF2000). National height datums in Europe should be transformed into EVRF datum NAP (Normaal Amsterdams Peil).

- **The EEA and the ETCs should use ETRS89 as the common coordinate reference system for storage of data and as a basis for defined projections to be used in analysis and map production. Data delivered to the EEA, in particular data with European coverage, should use ETRS89 as the coordinate reference system.**

- **National data delivered should also use ETRS89 or coordinate reference systems easily transformable to ETRS89. If the national/local coordinate system is not found in commonly accessible documentation, the delivering institution should add a documentation following the ISO19111 referred to below.**

The description and definition of ETRS89 is based on the convention of ISO19111, the 'Spatial referencing by coordinates' standard. For further documentation on ETRS89, see http://crs.ifag.de/ and http://www.eionet.eu.int/gis. For more on EVRS, see http://gi-gis.jrc.it/ws/evrs/.

2.3.2. Conversion from national coordinate reference systems

At national level, a series of different coordinate reference systems is used. It is essential that conversion is done with care, without losing significant accuracy. Therefore, proper transformation routines have to be observed.

The European initiative on coordinate reference systems also provides information at national level: the national mapping agencies or comparable institutions/organisations provide information for the descriptions of the national coordinate reference systems, and for transformation parameters between the

national coordinate reference systems and the European coordinate reference system ETRS89 and EVRS. For more information, see the website http://crs.ifag.de/

- **The EEA recommends that transformation between national systems and the European coordinate reference system be done by using the agreed transformation parameters for different countries (see the link above).**

2.4. EEA recommendations: specific projections for different purposes and products

The guidelines below are relevant for any organisation involved in handling geographical information systems (GIS) data to be delivered to the EEA, or in the treatment of such data on behalf of the EEA. The projection guidelines are also relevant to the EEA's own data use and management.

The European Commission recommends use of three different projections in different products and activities, all based on the ETRS89 datum. The choice depends upon scale, data quality (raster/vector) and purpose of work.

The EEA recommends the use of:

- **Lambert Azimuthal Equal Area (ETRS89-LAEA)**: for storing raster data, for statistical analysis and for map display purposes;
- **Lambert Conformal Conical (ETRS89-LCC)**: for storing raster data and for map display purposes;
- **Universal Transversal Mercator (ETRS89-TMzn or UTM)**: to be used in large-scale mapping and storage of large-scale data. Allow different zones to be used.

See http://www.eionet.eu.int/gis for detailed definition documents.

Coordinate reference system/ projection	Name and definition	Types of coordinates	Datum	When to be used – purpose	EEA use
ETRS-LAEA	**Lambert Azimuthal Equal Area 5210** Latitude of origin: 52 N Longitude of origin (central meridian): **10** E	Map projection	ETRS89	Small scale mapping 1:500 000 or smaller applications including - spatial analysis - storing raster data - map display covering Europe	Yes
	Lambert Azimuthal Equal Area 5265 Latitude of origin: 52 N Longitude of origin (central meridian): **65** E	Map projection	ETRS89	Small scale mapping 1:500 000 or smaller applications including - map display covering Euasia	Yes
ETRS-LCC	**Lambert Conformal Conical** Latitude of origin (Parallels) at 35 N and 65 N Longitude of origin (central meridian): 10 E	Map projection	ETRS89	Small scale mapping Only to be used for applications requiring an object to be rendered in its true shape	Yes
ETRS-TMzn (UTM)	**Universal Transversal Mercator** Different zones can be used	Map projection	ETRS89	Large-scale mapping 1:10 000–1:499 999	Yes

In the further treatment of the matter, it is necessary to distinguish between mapping, storage of geographical data, spatial analysis and map display.

Mapping/data acquisition: The EEA does not organise many large-scale mapping projects (projects including field survey, photogrammetry or other mapping techniques). Major projects, such as Corine Land Cover (CLC), have additional specifications for how to carry out the mapping. General guidelines are:

- to use the ETRS89 datum in all mapping projects;
- to use the ETRS-TMzn projection with a suitable zone or a well-documented local projection;
- to use latitude/longitude values referring to ETRS89 for point data, such as the mapping or recording of monitoring site locations.

Reporting, storage and dissemination of GIS data: The EEA and its topic centres are involved in merging national data into European datasets, carrying out spatial assessments to create new GIS datasets. The EEA stores and disseminates these data, and recommends that they be handled as follows:

- use the ETRS89 and EVRF NAP datum;
- report, store and disseminate **vector data** un-projected, including polygon data (e.g. watersheds), line data (e.g. rivers) and point data (e.g. towns, houses). There are two main exceptions:
    - for vector data that are only intended to be used in production of small-scale maps for reports, it is recommended to use ETRS-LAEA, 52 N, 10 E;
    - large-scale vector data (scale > 1:500 000), mapped in the countries using ETRS-TMzn or a well-documented local projection, should be reported and stored in this format;
- report, store and disseminate **raster data** in the following way:
    - European coverage or raster data: use ETRS-LAEA, 52 N, 10 E (e.g. CLC 2000 raster data merged as European dataset, elevation);
    - country-wise raster data or data with other regional split-up: use ETRS-TMzn or a well-documented local projection (e.g. from national Image 2000 data).

Measurements and spatial analysis: It is important to use a projection suited for the purpose.

- For European-wide measurements/analysis, the EEA recommends using ETRS-LAEA, 52 N, 10E as this is an area-true projection. It should be used when combining layers, measuring areas and distances, and in sampling processes for statistical purposes.

Maps in reports, factsheets and on the Web: The EEA has decided upon some common projections for all map presentations in main reports, factsheets and on the EEA websites, including the ETC and Eionet websites. Different projections were compared, leading to the following recommendations. All template files for maps available from http://www.eionet.eu.int/gis are based on these specifications.

- For **maps with European-wide coverage** or more limited coverage such as the European sea catchments, the seas or other major regions: use ETRS-LAEA, 52 N, 10 E.
- Exceptions are wide **Eurasian** maps using ETRS-LAEA, 52 N, 65 E, **world** maps using Times 10 E (WGS84) and maps showing **local** examples, where the preferred projection is ETRS-TMzn.
- If a map producer intends to use another projection than the one recommended, please contact the EEA using the web interface at http://www.eea.eu.int/help/infocentre/enquiries.

2.5. Available documents and files for working with projections

The EEA has developed template files for map production based on the recommendations above (see Chapter 8). The documentation for the coordinate reference systems can be found at http://ww.eionet.eu.int/gis and http://crs.ifag.de/.

2.5.1. prj files for shape file format

When using the general predefined projection files in ArcGIS software, be aware that ETRS89 is called ETRF89.

In ArcGIS it is possible to copy in your most used projections. Place prj files in the directory of projections. prj-files for the most common projections used by the EEA are available at the EEA data service at http://dataservice.eionet.eu.int/dataservice/metadetails.asp?id=587

- ETRS-LAEA5210.prj (recommended by the European Commission and EEA standard);
- ETRS-LAEA5265.prj (EEA standard for map presentations of Eurasia);
- ETRS-LAEA4809.prj (48 N, 9 E. Used by Eurostat/GISCO, where not WGS84).

When placed in the correct directory, these projections will be available as an option under predefined projections in ArcGIS 8.x. The prj-files should be placed in: arcexe8*x*/Coordinate Systems/Projected Coordinate Systems/Continental/Europe.

2.5.2. Projected coverages as ArcInfo template files

When projecting a coverage in ArcInfo 8.x, it is possible to activate the information in existing files with the correct projection. This is a helpful and easy-to-use method. The EEA offers coverages in the most common projections to ease transformations and definitions of coverage data.

3. Working with point locations: latitude/longitude

3.1. Background

A lot of data received by the EEA are georeferenced point locations in a tabular data format. Most of the data are tables with point locations for cities, water quality stations, waste treatment sites, oil spill sites, etc. Commonly, the EEA finds incorrect positions and position formatting in the delivered files for locations. If such errors are not identified early in the map production or analysis chain, it causes problems and an unnecessary workload.

Practical guidelines are provided below on how to create a file containing proper point location data.

3.2. Formatting latitude/longitude coordinates

Degrees/minutes/seconds (DMS) are a unit of measure for describing latitude and longitude. A degree is 1/360th of a circle. A degree is further divided into 60 minutes and a minute is divided into 60 seconds. However point data delivered in DMS format is not suitable for GIS systems. Therefore all point locations should always be delivered to EEA in latitude/longitude decimal degrees (DD) and not in DMS format. DD format is commonly accepted by GIS systems.

When delivering data at European scale, DD formatted points should have at least two decimals for obtaining an acceptable precision of location.

3.3. Conversion from DMS format to DD format

If registration is done in degrees, minutes and seconds (DMS), the data should be delivered as they are and, in addition, they should be converted to decimal degrees (DD) values.

Positions given in deg, min and sec relate to origin of coordinate system. The location value is linked with directions: north (N)–south (S) and east (E)–west (W). When converting the values from DMS to DD: N gives positive value, S negative, E positive, W negative.

Examples

YEAR	TONNES	LAT_DEG	LAT_MIN	LAT_NS	LONG_DEG	LONG_MIN	LONG_EW	LAT_DD	LONG_DD
1970	20 000	41	19	N	21	58	W	41.32	–21.97
1971	13 000	43	15.151	S	22	48.56	E	-43.253	22.809

Only the degrees and minutes are given here. The conversion to DD lat/long is done by leaving degrees as they are, and adding as decimals the min divided by 60 [formula: deg + (min/60) = DD]

The version below includes seconds.

LAT_DMS (DD°MM'SS")	LONG_DMS (DD°MM'SS")	LAT_DEG	LAT_MIN	LAT_SEC	LAT_NS	LONG_DEG	LONG_MIN	LONG_SEC	LONG_EW	LAT_DD	LONG_DD
58°56'05" N	17°51'35" E	58	56	05	N	17	51	35	E	58.9347	17.8597
7°32'10" N	18°03'46" E	7	32	10	N	18	03	46	E	7.5361	18.0628
58°12'44.45" N	17°51'48.05" W	58	12	44.45	N	17	51	48.05	W	58.2123	-17.8633

Here, the conversion to DD lat/long is done by leaving degrees as they are, and adding as decimals the min and sec by taking the min value and dividing by 60 and taking the sec value and dividing by 3 600 [formula: deg + (min/60) + (sec/3600) = DD]. Remember that west values should give negative 'long' values and south values should give negative 'lat' values.

4. GIS data delivery: vector and raster formats

This chapter addresses central issues about how the EEA and its partners should deliver and store GIS data.

GIS data are all data stored in a GIS format and with geographical referencing linked to a coordinate reference system. GIS data are used for different operations: for data collection, spatial analyses, assessments and for the production of maps. GIS data do not include maps pasted or stored in files without a reference system. Such maps are labelled postscript maps. Postscript files are, for example, AI, EPS, WMF, EMF, or PDF (see Chapter 7).

The EEA receives data from three main sources:

- countries responding to reporting obligations;
- ETCs merging national data into new European datasets and carrying out assessments resulting in new GIS data;
- third parties delivering reference data or other thematic data for spatial assessment and map production.

4.1. Quality and quality control

It is essential that data delivered to the EEA are homogeneous and of general good quality. Quality control includes the following questions:

- Are values and codes in tabular data within the range defined in guideline documents?
- Are 'ids' in accordance with standards?
- Does the geometry, either being points, lines or polygons, have an acceptable structure and topology, e.g. are polygons closed and lines forming networks linked properly to nodes?
- Do the geometric accuracy, coordinate reference system, projection and file format follow specifications?
- Are metadata filled in, including aspects of accuracy, coordinate system, methodology and source? A document listing the requested information is available from http://www.eionet.eu.int/gis.

Quality control must be carried out and documented before delivery of data to the Agency. In the flow of data from ETCs to the EEA, it is important that the ETC data managers are aware of the quality control procedures and ensure that they are posted to Circa in the ETC Consortium Interest Group, even if a partner organisation is responsible for the production task.

4.2. Projection and scale

The projection and scale of a vector dataset are fixed at the stage of product specification. Unless the Agency has provided written specifications to the contrary, the GISCO reference database should be used as basic reference data. This practice ensures that EEA datasets are compatible with each other and with the Commission GI/GIS projects. The GISCO reference database is distributed to ETCs by the EEA under the licensing agreement between Eurostat and the EEA.

4.3. Resolution and generalisation

Indicate the resolution and generalisation of a dataset as clearly as possible. These characteristics are important for usage of the dataset, in particular when the dataset is an input to geographical analysis and area measurements.

4.3.1. Resolution

The required resolution should be stated in the product specifications. The resolution is given in metres. The resolution is related to the scale in which the data are to be used.

1:10 000	ca. 3 metres
1:50 000	ca. 15 metres
1:100 000	30–50 metres
1:1 million	300–500 metres
1:10 million	3 000–5 000 metres

The GISCO reference database has the following resolutions:
1 million: 500 m
3 million: 1 500 m
10 million: 5 000 m
20 million: 8 000 m

4.3.2. Minimum mapping unit

Minimum mapping unit is related to the scale and resolution. The smallest mapped area for Corine Land Cover (CLC1990) is 25 ha (250 000 m^2) for mapping at 1:100 000.

The GISCO database uses the following limits in generalising from three million to smaller scales:

3 mill.: all areas smaller than 2 250 000 m^2 (225 ha) eliminated
10 mill.: all areas smaller than 25 000 000 m^2 (2 500 ha) eliminated
20 mill.: all areas smaller than 100 000 000 m^2 (10 000 ha) eliminated

4.3.3. Generalisation of lines/vectors

GISCO has stated that the following factors/parameters are to be used in generalising the NUTS boundaries (statistical regions in Europe) with the function *Bendsimplify* in Arc/Info:

3 mill.: weed tolerance 1 500 m
10 mill.: weed tolerance 4 500 m
20 mill.: weed tolerance 8 000 m

4.4. Geometric quality representation and topology

Provide a short description of the geometric quality of the dataset. If the original data have been converted from national systems, the conversion process should be documented. Maintain any available information concerning the geometric quality of original national data, either as an attribute in the vector dataset or as part of the written documentation/metadata.

4.5. Thematic quality

Provide a short description of the quality of the thematic attributes in the dataset. Indicate which attributes are original data (supplied by countries or third-party organisations) and which attributes are added by ETCs or other partners. The latter is often needed for the purpose of harmonising measurement units.

4.6. Naming of files and attributes

Naming of files and attributes should normally follow the style recommended by the GISCO database manual. If this is not considered practical, then an alternative proposal should be made to the responsible person in the EEA topic team with a copy to the EEA GIS team.

4.7. Recommended formats for geographical datasets

Geographical datasets can either be vector data, raster data or tabular data. The EEA provides recommendations on the data formats for each of these data categories. The recommendations are relevant for:

- the EEA in its internal data handling and dissemination;
- ETCs;
- national organisations delivering data to the EEA through Eionet data flows;
- other external contractors.

The EEA follows the European Commission decision to use ESRI products and formats where possible. The tables below list the formats handled by the EEA, indicating the preferred ones.

In addition to format recommendations, the EEA requires certain metadata for all geographical data deliverables, including detailed description of the geographic reference system. If possible, provide ESRI projection files (*.prj). Metadata issues are treated further in Chapter 9.

4.7.1. Raster formats

Raster datasets can be delivered as one band or a collection of bands for each image (scene). If several images are supplied in a dataset, include a raster catalogue in the delivery. A raster catalogue is a table with columns IMAGE, XMIN, YMIN, XMAX and YMAX. Any table format is accepted.

If a raster dataset is created on the basis of a vector to raster conversion, please deliver the vector dataset along with the raster dataset (if feasible).

Name	Short name	Recom-mended	Comments	Advantages	Disadvantages
IMAGINE Image	**IMG**	**Yes**	**Preferred by EEA**	**Compatible with most GIS software; High compression ratio without data loss; Supports any colour depth; Detailed header information**	**ERDAS specific format**
Geographic Tag Image File Format	GeoTIFF	Yes	Must include GeoTIFF tags in header	Supported by most GIS, image and remote sensing tools	
ArcSDE Raster	SDERaster	No		Easy and fast ESRI ArcSDE export/import	Only useful for users with ArcSDE
MrSID		No	Use only compression level 1:10	High compression ratio	Only 32 bit colour; Manipulates data
Band Interleaved by Line, Band Interleaved by Pixel, Band SeQuential	BIL, BIP, BSQ	No	Must include header file (*.hdr) and colormap file (*.clr)	Supported by most remote sensing tools.	Various non-compatible versions used; Missing some information about the used geographic reference system
ESRI GRID	GRID	No	Must include colormap file (*.clr)	Old accepted format; Contains both bands and catalogues	Uses folder structure; Unreliable

4.7.2. Vector formats

If a vector dataset is extracted from a database, please describe the extraction process steps in the metadata.

Format name	Short name	Recom-mended	Comments	Advantages	Disadvantages
Shape file	**SHP**	**Yes**	**Preferred by EEA**	**Compatible with most GIS software**	**Datasets having several types of shapes (feature classes) or several tables need more than one shape file/table file; Cannot keep relations between feature classes within the dataset**
ESRI coverage	COV	No	Deliver with the coverage folder structure fully intact	Supports topology.	Disk folder structure; Only supported by ESRI; Many versions; Discontinued
ArcInfo export interchange file	E00	No	For export between old ESRI ArcInfo systems		Non-generic format; Designed for data exchange between old ESRI systems

Drawing interchange files	DXF	No	AutoCAD format		Made for CAD drawings
AutoCAD drawing files	DWG	No			
MicroStation design files	DGN	No	Old MicroStation format		
Vector Product Format	VPF	No	A coverage format	Supports topology	

4.7.3. XML formats

Format name	Short name	Recom-mended	Comments	Advantages	Disadvantages
Geography Markup Language, version 2.1.2 or 3.0	**GML**	**Yes**	**Preferred by EEA**	**Future standard of exchanging vector data**	**Still under development. Takes up a lot of space**

4.7.4. Table formats

Datasets only including points may be delivered as tables with an X and Y coordinate (see also Chapter 3).

Format name	Short name	Recom-mended	Comments	Advantages	Disadvantages
Microsoft Access Database	**MDB**	**Yes**		**Stores multiple tables as a relational database**	**Each table as one file**
dBASE5	**DBF**	**Yes**	**Only point shapes**	**Easy to use; Accepted by all systems**	**Each table as one file**
Microsoft Excel	XLS	No	Only point shapes	Easy to use; Accepted by many systems	Each table as one file; Conversion to other format needed to use in ArcGIS
Comma separated text file	TXT	No	Only point shapes	Accepted by all systems	Characters might be read differently depending on system
VPF table	VPF	No			Only supported by GIS systems

4.7.5. Database formats

Please consult with EEA GIS operations before submitting a full or an extract of a database.

Format name	Short name	Recom-mended	Comments	Advantages	Disadvantages
ESRI Personal Geodatabase (Microsoft Access)	**MDB**	**Yes**	**Preferred by EEA**	**Supports topology and feature relations**	**Does not support raster**
Standard Microsoft Access	MDB	Yes	Only points. Uses an OLE DB connection	No need for a GIS system	Only supported by Windows systems
ESRI multiuser geodatabase	SDE	No	EEA only reads SQLserver	Handles huge amounts of data	Complex and needs slots of documentation describing database

4.7.6. Annotation formats

Format name	Short name	Recom-mended	Comments	Advantages	Disadvantages
Personal geodatabase annotations	**MDB**	**Yes**	**Created with ArcMap**	**Integrated with other formats; Easy to work with**	
Annotation Coverage	COV	No	COGO		Old format; Difficult to work with

4.7.7. Geoservice formats

The EEA accepts that geographical datasets are made available to the EEA as Internet geoservices. The EEA handles datasets delivered as OGC Web Map Service 1.1 and OGC Web Feature Service 1.0. Please contact EEA GIS operations for further information using the web interface at http://www.eea.eu.int/help/infocentre/enquiries.

5. Working with grids

5.1. Introduction

Spatial reference is a fundamental property of data used in environmental analyses and assessments. The location of an object is in most cases stored as 'direct position' based on a coordinate reference system specifying the geodetic datum and a coordinate system. However, spatial reference based on 'indirect position' is also interesting when managing environmental data. One of the most common methods of storing spatial information with indirect position is by using spatial reference grids. Grids omit direct spatial reference and average the qualitative properties of the subject. This makes them powerful tools for harmonisation and reduction of the complexity of spatial datasets. Spatial reference grids are also effective communication means for reporting spatial variability of features.

Technically, grids for geographical data are predefined spatial reference structures composed of cells regular in shape or area. Cells are usually squares based on a given geographical coordinate system but, in rare cases, they can be shaped differently, e.g. as hexagons.

5.2. Examples of grids used in environmental mapping

Air pollution, ozone and UV
Grids are used for presenting data on atmospheric and air pollution. Examples are data on emissions and deposition of air pollutants such as nitrogen or sulphur, but also concentrations in soil as a result of air-borne deposition. Specific usage of a spatial reference grid is related to ecosystem exposure expressed through calculated critical loads and exceedances of ecosystems' buffering capacity. Grids are also used for indicating spatial variation of exposure to ultraviolet radiation and depletion of the stratospheric ozone layer.

Biodiversity assessment
Species distributions such as used by the *Atlas Florae Europaeae* are mapped by grid cells for mapping and assessment of biodiversity. Several European research institutes use a coordinated approach to map the distribution of, for example, plant species, birds, amphibians and mammals.

Climate change and hydrology
Temperature changes registered on the longitude/latitude grid and average annual runoff distribution are examples of applying reference grids in the area of climate change and hydrology.

Land cover and soil
Grids are also used for mapping of land cover, e.g. the Corine Land Cover project. Even if the original database is created as vector data, the grids are used for data distribution because this format has less volume and is often more suitable for analysis at a regional and European scale such as ecosystem fragmentation or soil erosion risk assessments.

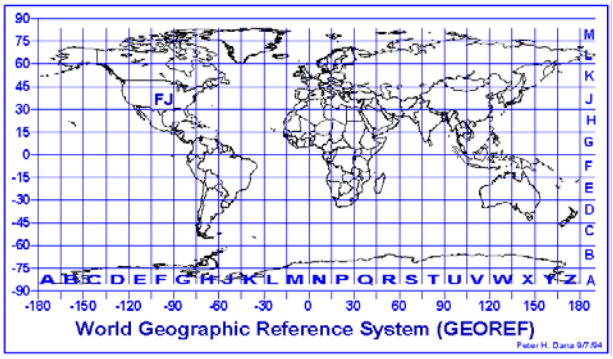
5.3. Types of reference grids

There are many types of grids available for different purposes. Ideally, one grid that is useful for all purposes ought to be created but it is not possible for one grid to cover uniformly the whole of

Europe. Any one type of grid will always have some disadvantages that disqualify it for certain use. Therefore it is important to understand the advantages and disadvantages inherent in a given grid type. The following grid examples are presented to help identify suitable types of grids for different applications. In chapter 5.4 you will find recommendations for selecting or defining a grid, as well as definitions for the recommended multipurpose grid called ETRS-LAEA5210.

5.3.1. World geographic reference system grid

The world geographic reference system (Georef) is made for aircraft navigation. It is also suitable for grid mapping with world coverage. Georef is based on geographical latitude and longitude. The globe is divided into 12 bands of latitude and 24 zones of longitude, each 15 degrees in extent. These 15-degree areas are further divided into one-degree units identified by 15 characters. Georef disadvantages are that the shape, area and distance of cells are distorted.

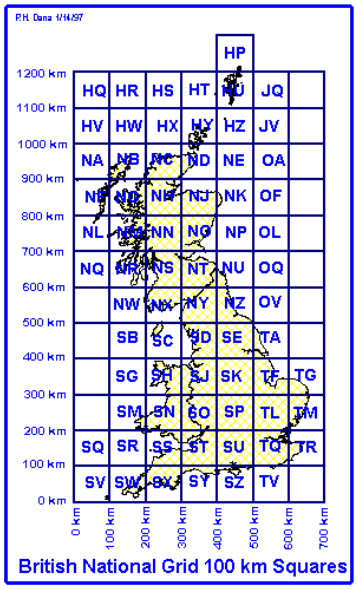


5.3.2. National grid systems

Most countries have defined grid systems based on coordinates that cover their territory. Belgium, Great Britain, Denmark, Finland, Ireland, Italy, the Netherlands and Sweden are examples of countries that have defined a national grid system.

National example: The British National Grid

- The British national grid (BNG) was based initially on the national grid system of England, administered by the British Ordnance Survey.
- The BNG has been based on a Transverse Mercator projection since the 1920s.
- The modern BNG is based on the Ordnance Survey of Great Britain Datum 1936 (Airy Ellipsoid).
- The true origin of the system is at 49 degrees north latitude and 2 degrees west longitude.
- The false origin is 400 km west and 100 km north.
- Scale at the central meridian is 0.9996012717.
- The first BNG designator defines a 500 km square.
- The second designator defines a 100 km square.



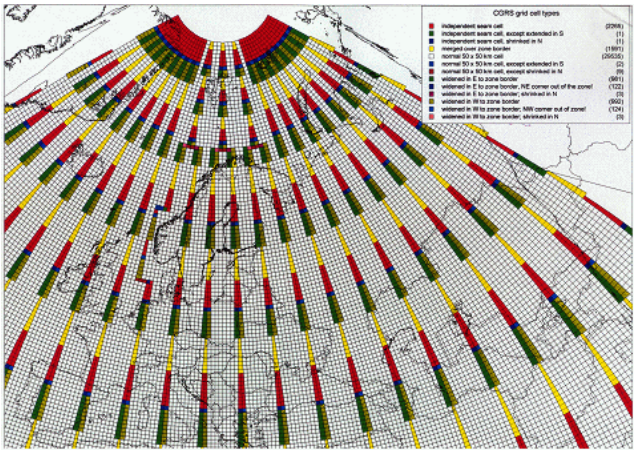
5.3.3. *Equal area grids*

Equal area grids are suitable for generalising data, statistical mapping and analytical work where an equal area of cells is important.

Corine Land Cover uses an equal area grid in the Lambert Azimuthal Equal Area projection and ETRS89 datum. Corine Land Cover is produced with a grid size of 100 m, 250 m, 1 km and 10 km grid sizes. The land cover grid is generalised from original vector land cover data.

5.3.4. *Common European chorological grid reference system (CGRS)*

The CGRS grid is modified from the military grid reference system (MGRS). The MGRS itself is an alphanumeric version of a numerical UTM (Universal Transverse Mercator) or UPS (Universal Polar Stereographic) grid coordinate. In the year 2000, representatives of the atlas groups mapping European vascular plants, mammals, birds, amphibians, reptiles, fungi and invertebrates also agreed to use the MGRS as a common grid for species distribution mapping.

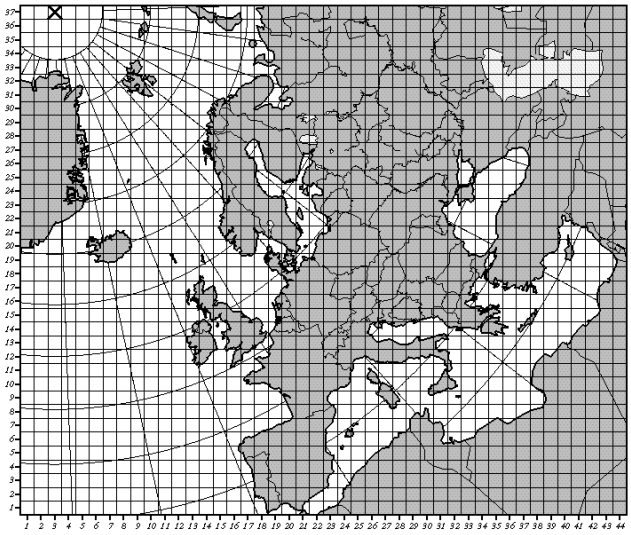


MGRS have some serious disadvantages. Cells do not cover the same area or have the same length of sides along latitude. This implies that cell statistics are difficult to calculate. On the other hand, MGRS is widely known and many datasets are using the MGRS grid.

5.3.5. EMEP grid

The EMEP (Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air pollutants in Europe) projection is a polar-stereographic projection with two available cell sizes: 50 km grid and 150 km grid. The EMEP grid is based on this projection and designed with minor cell distortion for European coverage.
It is difficult to combine the EMEP grid with other grids or data based on common projections, because the major axis of the EMEP projection does not coincide with any longitude, i.e. it is not north–south oriented. EMEP has its own orientation of the axis. This makes transformation routines of coordinates mathematically complex and, therefore, few tools are available for carrying out these transformations.

Extended EMEP grid - 150 km



An example of use is for monitoring the Convention on Long-Range Transboundary Air Pollution (CLRTAP).

Find more information on EMEP grids at http://www.emep.int/grid.

5.4. Recommendations for selecting or defining a grid

The recommendations given here are generalised and made from the EEA's point of view. A recommended grid type may be different from the user's need. The recommendations are largely collected from the various assessment reports created by the EEA and presented at the first Workshop on European Reference Grids in Ispra, 27-29 October 2003.(Prodceedings are available from the EIONET GIS page (http://www.eionet.eu.int/gis).

Recommended multipurpose grid: EEA reference grid ETRS-LAEA 52N 10E
EEA recommend the use of the multipurpose European grid based on Lambert Azimuthal Equal Area ETRS89 latitude of origin 52 N and longitude of origin 10 E (ETRS-LAEA), as recommended at the "1st European Workshop on Reference Grids".

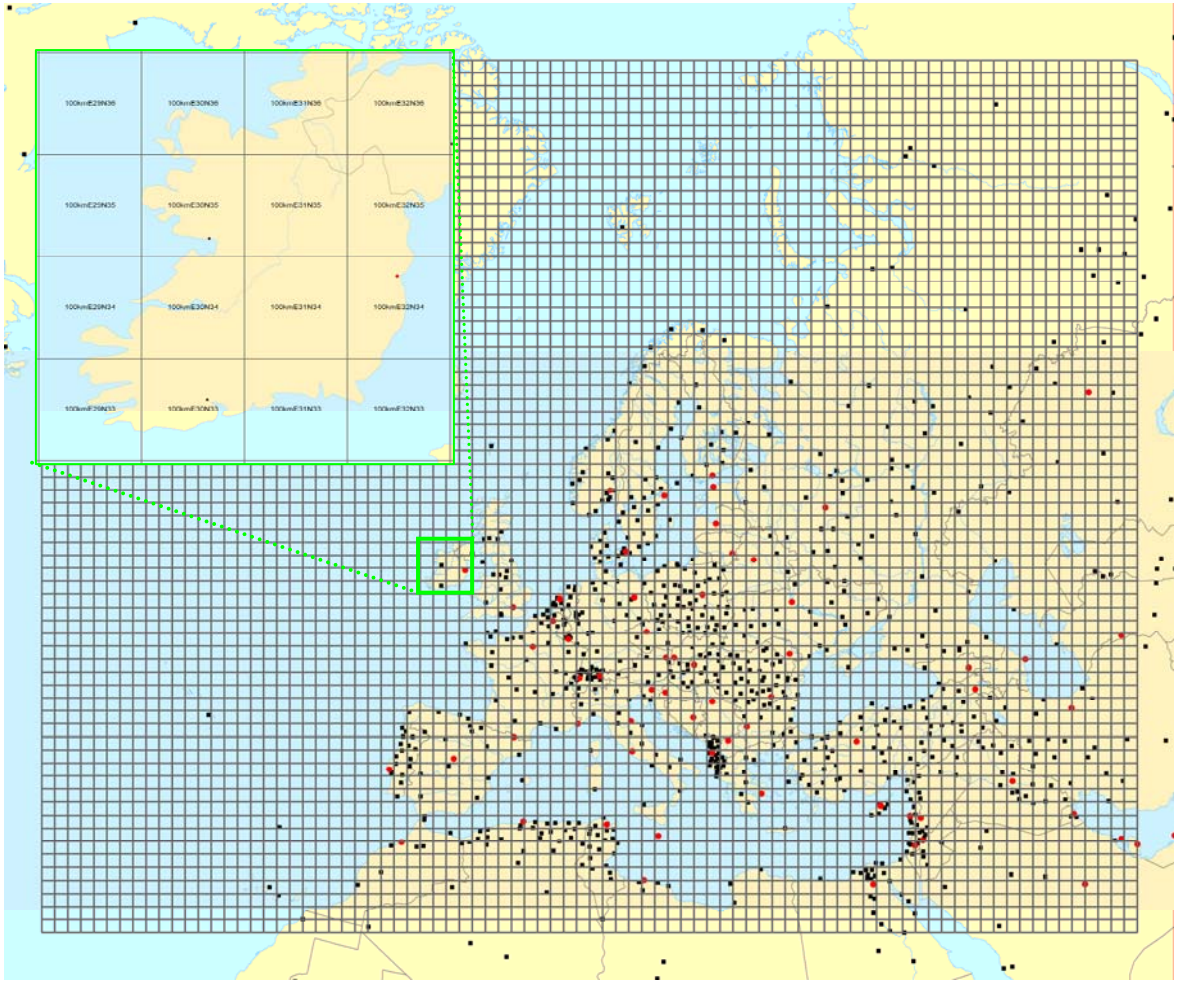
Definitions for ETRS-LAEA 52N 10E

- Use ETRS89 Lambert Azimuthal Equal Area [ERTS-LARA] geographic coordinate system as described in chapter 2. Use centre grid point: 52N 10E, false easting: 4321000,0 m, and false Northing: 3210000,0.
- EEA recommend grid size of metric resolution in standard size 100 m, 1 km, 10 km and 100 km. Alternatively use 25 m or 250 m for analysis purposes, where standard 100 m or 1 km grid size is not appropriate.

Sample grid in line vector format of resolutions 100m, 1 km, 10 km and 100 km, and polygon grid in 10 km and 100 km, can be downloaded from EEA data service. These sample grids are useful for validation and analysis of in GIS systems not supporting ETRS-LAEA grid.

Accepted shortnames used for projection is ETRS-LAEA, ETRS-LAEA 52N 10N or ETRS_LAEA5210.

See description of ETRS-LAEA projection at homepage for Information and Service System for European Coordinate Reference Systems – CRS, link http://crs.bkg.bund.de/crs-eu/



Map illustrates a sample of the 100 km ETRS-LAEA grid. This sample grid covers in kilometres from 0 x (East of origin / column number) and 700 y (north of origin / row number) to 6700 x and 9100 y. Inset map shows zoom of Ireland 100 km grid with cell code.

Recommended grid coding system

EEA have defined a coding system useful for identifying a unique cell. The coding is formatted as a text string with information on grid size, and coordinates in the grid. Coding is for identifying or referring to a unique cell.

The coding system is a direct coordinate type of coordinate coding system. A coding system where it's the cell resolution and cell positioning that defines the cell code, and with a coding structure that is easily readable.

Formatting cell code

Cell code is composed by *size of cell,* the *meters east (E)* and *meters north (N)* from false origin to lower left cell corner.

Cell size in meters is formatted to m (meter) or km (kilometre) depending of cell size.
Example: 10000 meters is changed to 10km.

East of origin is the X axis in meters from ETRS-LAEA false origin. *North of origin* is the Y axis in meters from ETRS-LAEA false origin. False origin is the origin with false easting and false northing added. In other words, where the coordinates starts in (0,0) meters of projection.

To reduce length of east and north string, cell size in meters is divided by 1exp(number of zeros) of cell size.
Example: Cell size is 1000 meters. Number of zeros in end is 3. Divider is 1exp(3) = 1000.

In true sense E and N refer to column and row of the grid, but these terms are used for more intuitive understanding even if E and N are not oriented to true East and North of the coordinate system.

For computations and analysis do not use CellCode. Use instead lower left corner coordinate in meters, formatted as two separate integers attribute values named EOFORIGIN and NOFORIGIN.

OBJECTID*	CELLCODE	EOFORIGIN	NOFORIGIN	Shape*
1970	100kmE29N33	2900000	3300000	Polygon
2038	100kmE30N34	3000000	3400000	Polygon
2106	100kmE31N35	3100000	3500000	Polygon
2174	100kmE32N36	3200000	3600000	Polygon

Figure illustrate a screenshot of table view of the ETRS-LAEA 10 kilometre grid create with the EEA ETRS-LAEA fishnet tool.

Example: Defining a cell code for a 1 kilometre grid
*Distance from false origin, **11000** meters east and 1**20000** meters north. Cell size is **1000** meters.*

*1. Define resolution string: 1000 meters => "**1km**"*
*2. Identify multiplier in number of zeros to remove from E and N value, to reduce number of zeros in E and N string: The number 1000 has 3 zeros in end => divide E and N by 1exp(3) = **1000**.*
*3 .Define east string: 11000 meters divided by 1000 => **1***
*4. Define north string: 120000 meters divided by 1000 => **12***
*5. Concatenate string: **1kmE1N12***

Example: Defining a cell code for a 250 meter grid
*Distance from false origin, **10250** meters east and **220000** meters north. Cell size is **250** meters.*

*1. Define resolution string: 250 meters => "**250m**"*
*2. Identify multiplier in number of zeros to remove from E and N value, to reduce number of zeros in E and N string: The number 250 has 1 zero in end => divide E and N by 1exp(1) = **10**.*
*3 .Define east string: 10250 meters divided by 10 => **1025***
*4. Define north string: 220000 meters divided by 10 => **22000***
*5. Concatenate string: **250mE1025N22000***

Tools for creating Grids ETRS-LAEA using ESRI ArcGIS

Creating vector grid

Using the "EEA FishNet tool for ESRI ArcCatalog", you can create the ETRS-LAEA reference grid according to standards. Grid can be produced in polygon (squares) or in line vector format. The recommended grid coding system is automatically added to the produced grid as attributes. Tool is available from EIONET GIS page (http://www.eionet.eu.int/gis).

Creating raster grid

Using ESRI ArcGIS Spatial Analyst extension it's possible to create a LAEA-ETRS grid. You can create a clean grid with no data, or create a grid based on other data, like a feature dataset. Consult the online help for ArcGIS Spatial Analyst for more information.

Selecting a custom grid

A custom grid is a grid that is not yet defined. For some projects a custom grid has to be designed to facilitating specific analysis, mapping or data collection purposes. This paragraph identify some of the issues that should be taken into account

When selecting a custom grid following issues should be noted;

- Use of ETRS89 (GRS80) datum for the grid projection. A grid based on a projection using ETRS89 can easily be combined with other grids and data using the European accepted ETRS89.
- If possible, use one of the agreed European projections such as Lambert Azimuthal Equal Area, Transverse Mercator and Lambert Conic Conformal (see Chapter 2).
- Ensure efficiency for data storage and access assured through hierarchical data structure with square shaped cells.
- Use logarithmic decimal grid sizes. For example, 10 m, 100 m, 1 km, 10 km, 100 km or alternatively quadratic subdivision of the grid cell such as 25 m and 50 m for the 100 m grid, 250 and 500 m for the 1 km grid cell, etc. This eases computation on data such as generalisation, statistics and storage.
- Consider the future of dataset. Will the selected grid support possible extension of coverage and will it allow easy use with other related data?
- Quality of data; the resolution of the selected grid must correspond to spatial variability of mapped feature in order to capture relevant detail. Do not use grid cell sizes below the accuracy of data. Instead, generalisation of the grid to coarser resolution (larger cells) is allowed.
- Identifying if the grid is suitable for the data collection or mapping.

General technical concerns when using grids

- Make sure hardware and software are prepared for the selected grid type and able to support the data collection and analytical processes.
- Take time to understand how selected algorithms for manipulation and analyses on grids are working. If you do not understand the algorithms, it is impossible to guarantee that the output will be exactly what you expected.
  An example: Generalisation from a thematic vector layer to a thematic grid. Some algorithms allocate the thematic value of the centre point of the vector layer cell to the thematic cell value of the grid. In situations where statistics are later done on an area, this is not a useful approach. The cell value should in this case represent the value of the most significant thematic value within the area of the cell. It does not necessarily coincide with the centre point. In this example, an algorithm selecting thematic value on majority area instead of centre point should be used.

6. Map extents used by the EEA

The EEA has developed a set of defined map extents to cover all 'standard' needs. The map extents have been used in *Environmental signals* reports and *Europe's environment: the third assessment*, and are expected to be used in all future EEA publications and information material.

6.1. Map extents: north, south, east, west

When defining map extents (north–south, east–west) the following aspects were considered:

- Covering the needs for standard maps in reports, roughly covering some 70–80 % of the total needs. There will always be additional maps in other sizes and formats;
- Ability to reuse and mix data from different productions. In earlier productions, it has been difficult to reuse map components in maps based on different productions as map extents and projections have varied;
- Reusability also requires a standard reference coordinate system and projection. Most of the maps are based on the projection: Lambert Azimuthal Equal Area projection 52 N, 10 E or Lambert Azimuthal Equal Area projection 52 N, 20 E (see Chapter 2). Some maps extending outside Europe use other parameters and projections;
- Harmonious appearances of maps;
- Map sizes that fit report layout standards (Chapter 7).

6.2. Recommended map extents: a full series

The map extent series are defined according to **east–west** coverage:

- Map Extent 1 EU-25 + EFTA
- Map Extent 2 EU-25 + EFTA + three candidate countries (CC-3), *EEA coverage*
- Map Extent 3 EU-25 + EFTA + CC-3 + Caspian Sea
- Map Extent 4 EU-25 + EFTA + CC-3 + Caspian Sea + Canary Islands
- Map Extent 5 EU-25 + EFTA + CC-3 + Caspian Sea + North Atlantic + North Pole
- Map Extent 6 EU-25 + EFTA + CC-3 + EECCA, narrow (full Russia)
- Map Extent 7 EU-25 + EFTA + CC-3 + EECCA, wide (full Russia)
- Map Extent 8 World
- Map Extent 9a Countries of Mediterranean Sea region
- Map Extent 9b Mediterranean Sea
- Map Extent 10 EU-25 + EFTA + CC-3 + EECCA (Russia partly)

See http://dataservice.eea.eu.int/dataservice/geonotes.asp for further explanation of the abbreviations above.

Each of the map types 1, 2, 3, 6 and 10 can have four different versions, depending on **north–south** extent (see Figure 6.1):

- core
- core + north extension
- core + south extension
- core + north and south extensions

Map 4 and 8 can have two different versions, depending on north–south extent:

- core
- core + north or south extensions

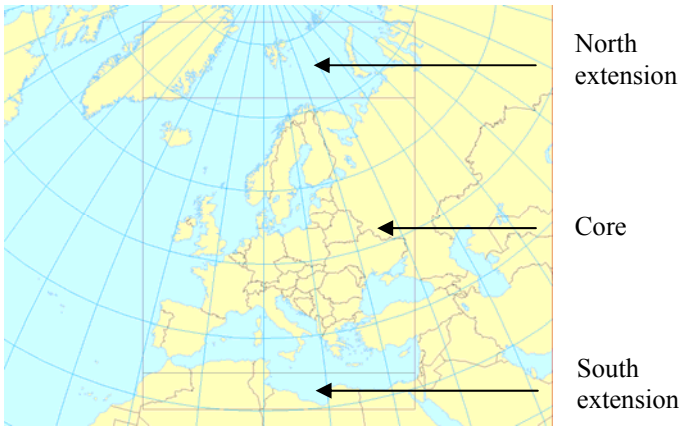
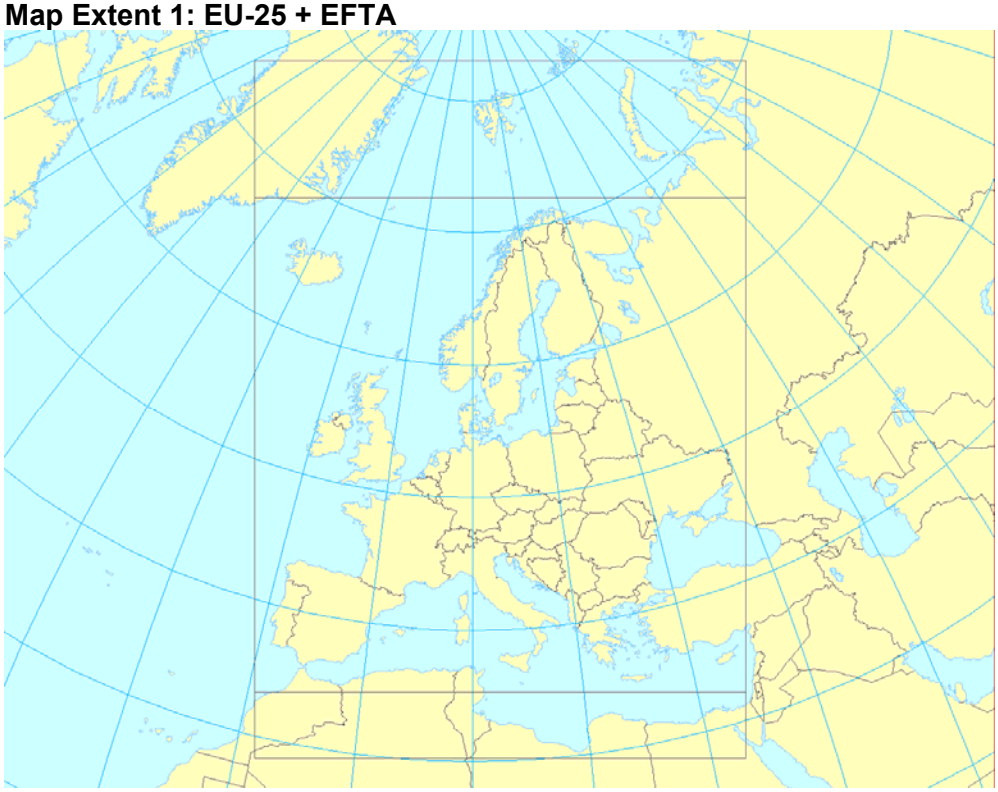


Figure 6.1: Example of a map extent and its possible extensions to the north and south. The map number refers to an extent in east–west direction.

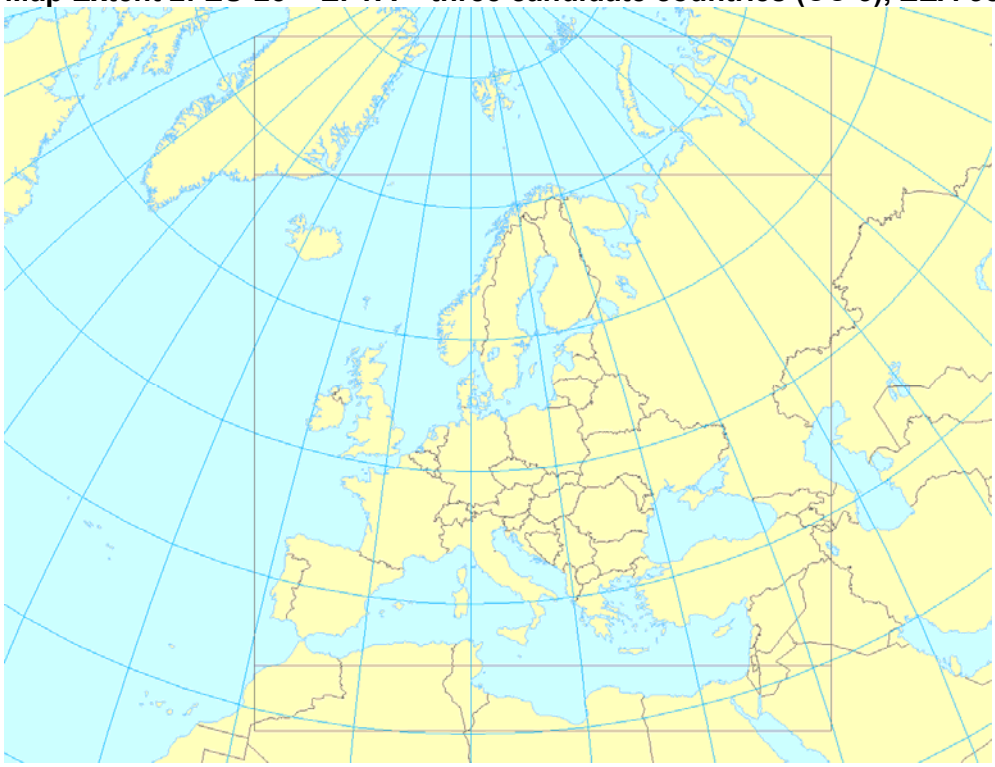
6.3. Map extents: illustrations of EEA map extent series

The following pages present the series of agreed map extents. The Powerpoint presentation 'EEA standard map extents' at http://www.map.eea.eu.int/gis shows the same map extents and examples of different map extents pasted into dummy pages. Legends are not made in the examples. Legends should be placed outside the maps (see Section 7.9).

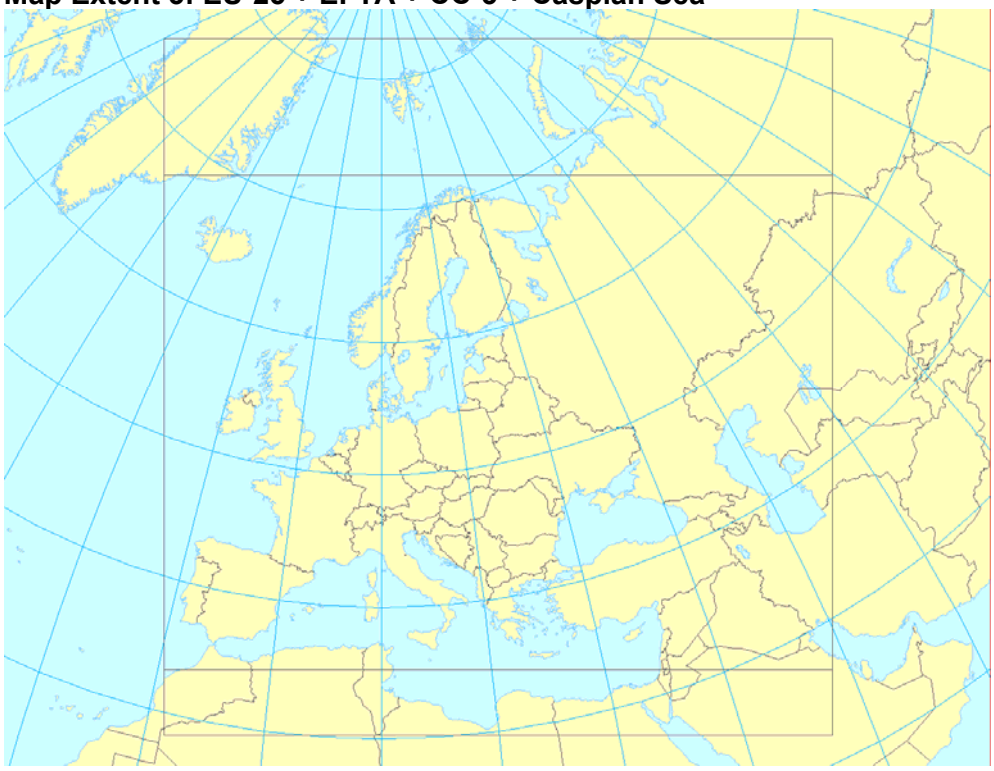
Map Extent 1: EU-25 + EFTA



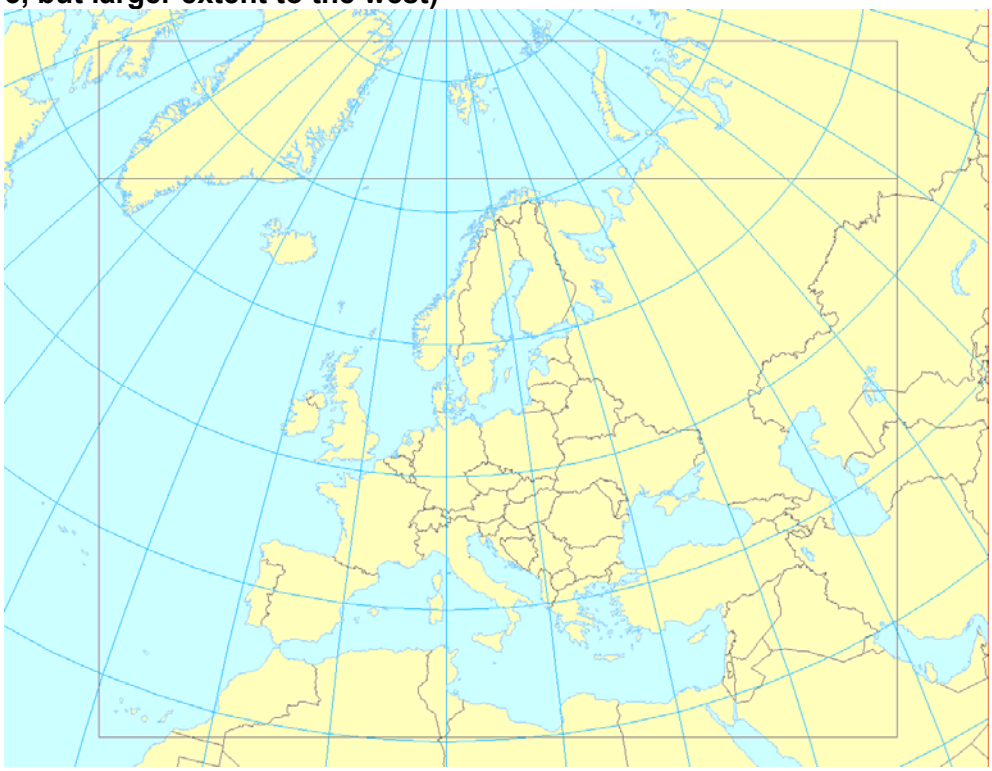
Map Extent 2: EU-25 + EFTA + three candidate countries (CC-3), *EEA coverage*



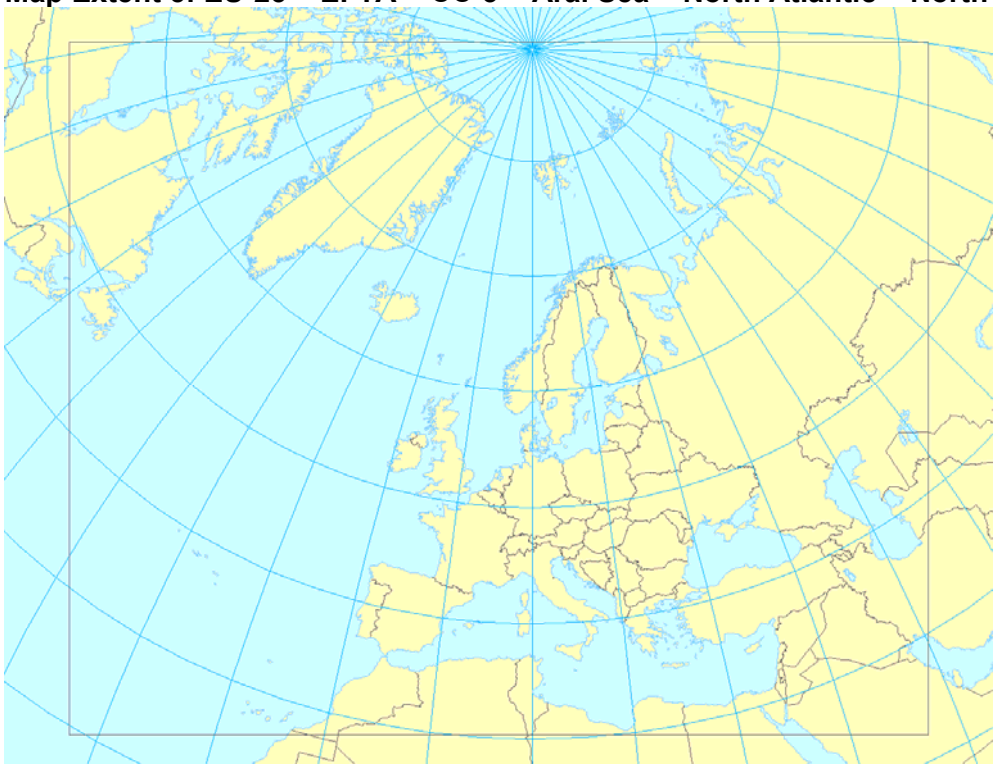
Map Extent 3: EU-25 + EFTA + CC-3 + Caspian Sea



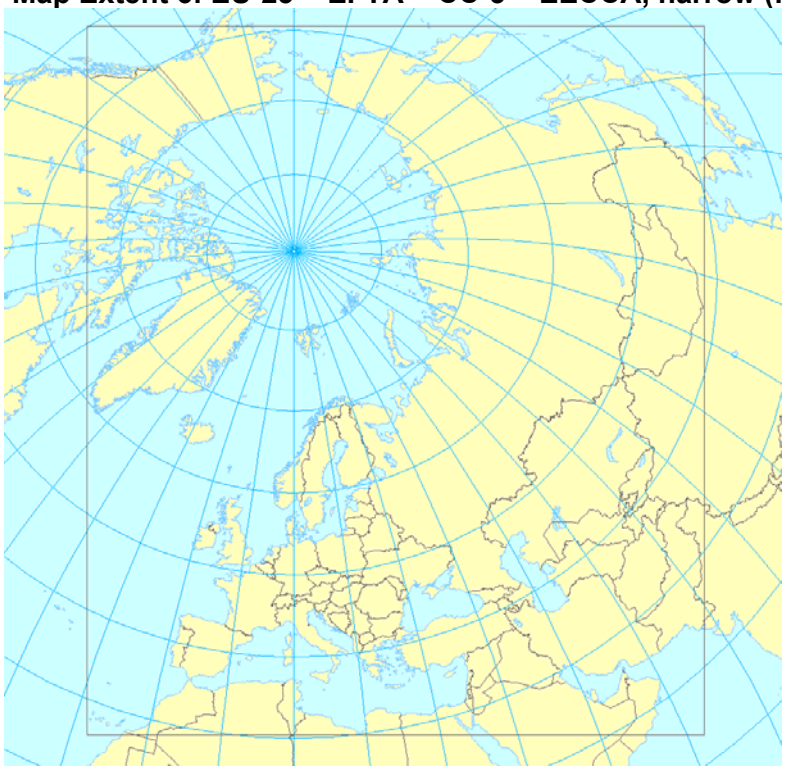
Map Extent 4: EU-25 + EFTA + CC-3 + Caspian Sea + Canary Islands (similar to map 3, but larger extent to the west)



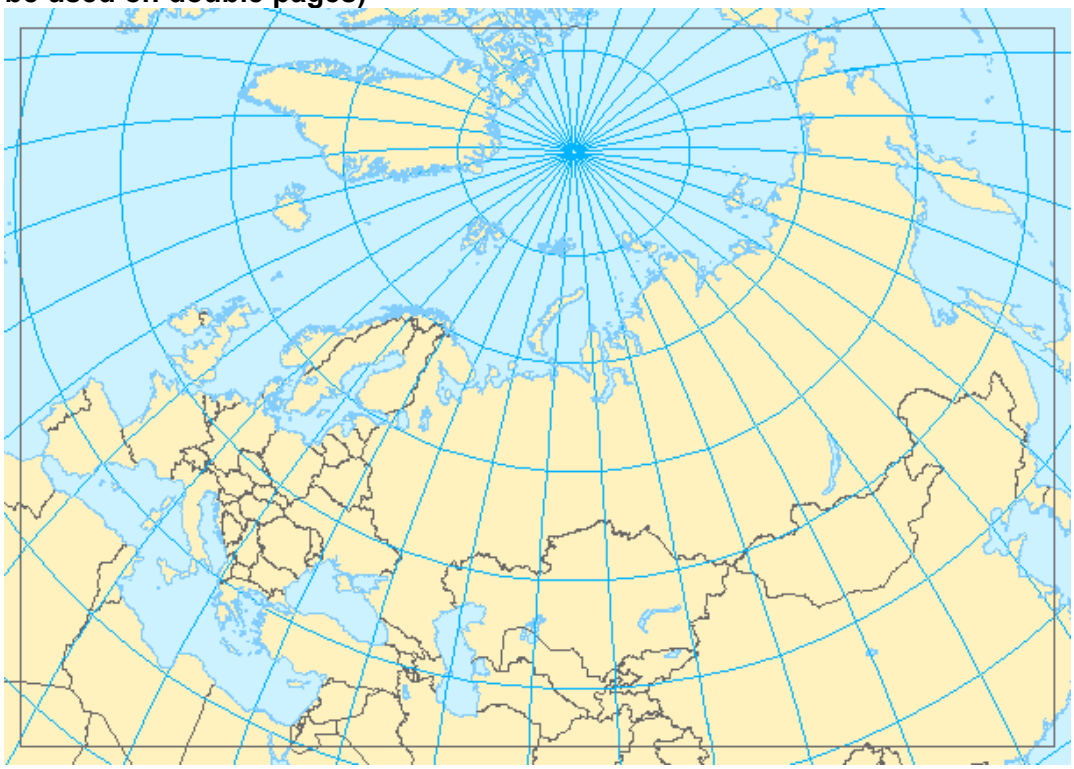
Map Extent 5: EU-25 + EFTA + CC-3 + Aral Sea + North Atlantic + North Pole



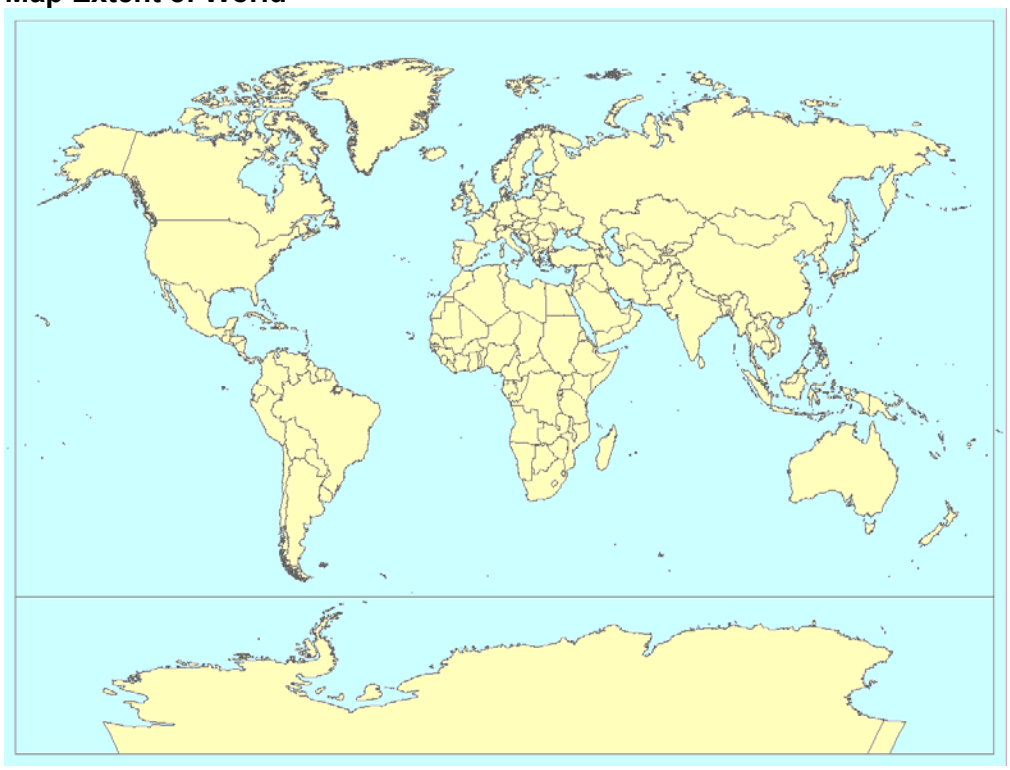
Map Extent 6: EU-25 + EFTA + CC-3 + EECCA, narrow (full Russia)



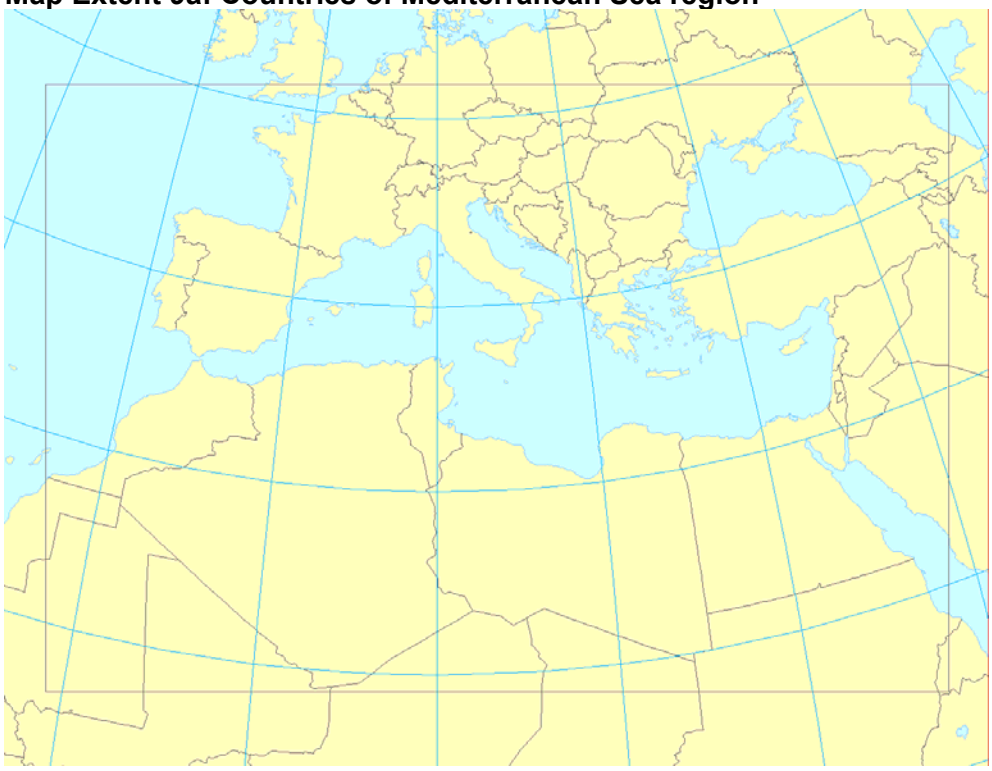
Map Extent 7: Europe and Central Asia (covers the same area as map extent 6; to be used on double pages)



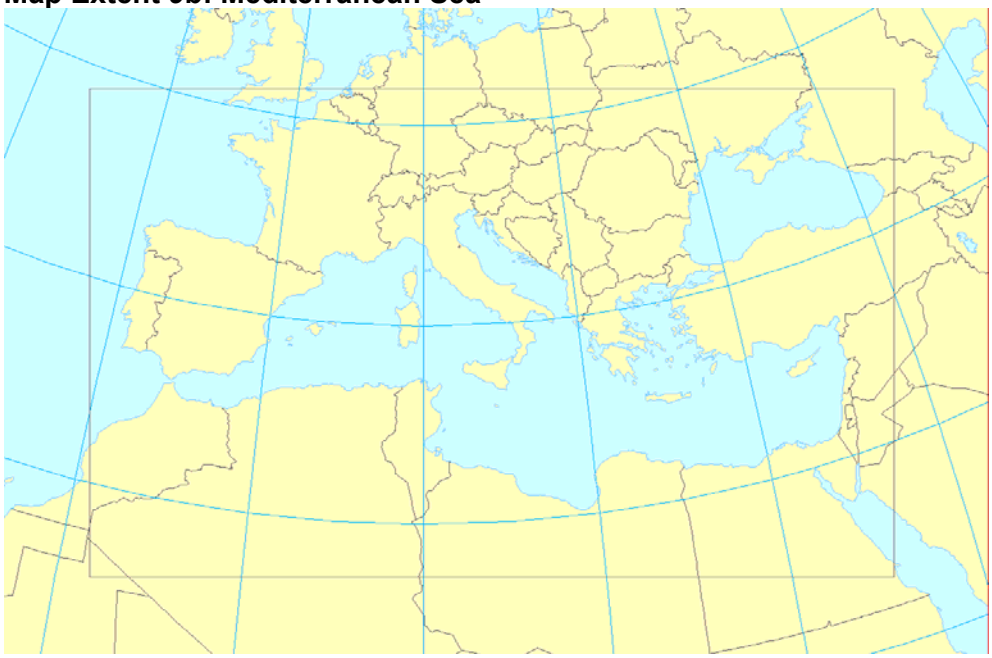
Map Extent 8: World



Map Extent 9a: Countries of Mediterranean Sea region



Map Extent 9b: Mediterranean Sea



Map Extent 10: EU-25 + EFTA + CC-3 + EECCA (part of Russia)

6.4. Specification of map extents by coordinates

All values given in coordinates related to the projection specified.

Map extent	Projection	NS min.	NS max.	EW min.	EW max.
Map 1c	LAEA-52N-10E	1 350 000	5 500 000	2 500 000	6 600 000
Map 1c insert	LAEA-52N-10E	750 000	5 500 000	2 500 000	6 600 000
Canary Is.		770 000	1 300 000	1 400 000	2 120 000
Açores Is.		2 150 000	2 700 000	780 000	1 500 000
Madeira Is.		1 380 000	1 650 000	1 640 000	2 030 000
Map 1 c+s	LAEA-52N-10E	800 000	5 500 000	2 500 000	6 600 000
Map 1 c+n	LAEA-52N-10E	1 350 000	6 650 000	2 500 000	6 600 000
Map 1 c+ns	LAEA-52N-10E	800 000	6 650 000	2 500 000	6 600 000
Map 2 c	LAEA-52N-10E	1 350 000	5 500 000	2 500 000	7 350 000
Map 2 c insert	LAEA-52N-10E	650 000	5 500 000	2 500 000	7 350 000
Canary Is.		770 000	1 300 000	1 400 000	2 120 000
Açores Is.		2 150 000	2 700 000	780 000	1 500 000
Madeira Is.		1 380 000	1 650 000	1 640 000	2 030 000
Map 2 c+s	LAEA-52N-10E	800 000	5 500 000	2 500 000	7 350 000
Map 2 c+n	LAEA-52N-10E	1 350 000	6 650 000	2 500 000	7 350 000
Map 2 c+ns	LAEA-52N-10E	800 000	6 650 000	2 500 000	7 350 000
Map 3 c	LAEA-52N-10E	1 350 000	5 500 000	2 500 000	8 100 000
Map 3 c+s	LAEA-52N-10E	800 000	5 500 000	2 500 000	8 100 000
Map 3 c+n	LAEA-52N-10E	1 350 000	6 650 000	2 500 000	8 100 000
Map 3 c+ns	LAEA-52N-10E	800 000	6 650 000	2 500 000	8 100 000
Map 4 c	LAEA-52N-10E	800 000	5 500 000	1 400 000	8 100 000
Map 4 c+n	LAEA-52N-10E	800 000	6 650 000	1 400 000	8 100 000
Map 5	LAEA-52N-10E	800 000	7 450 000	-100 000	8 100 000
Map 6	LAEA-52N-10E	800 000	10 450 000	1 500 000	9 900 000
Map 7	LAEA-52N-65E	1 275 000	8 650 000	2 800 000	13 350 000
Map 8 c	Times10E	- 6 200 000	10 850 000	- 14 500 000	14 500 000
Map 8 c+s	Times10E	- 10 850 000	10 850 000	- 14 500 000	14 500 000
Map 9a	LAEA-52N-10E	- 402 000	3 200 000	1 789 000	7 350 000
Map 9b	LAEA-52N-10E	479 000	3 200 000	2 460 000	6 950 000
Map 10a c	LAEA-52N-10E	1 350 000	5 800 000	2 500 000	9 450 000
Map 10a c+s	LAEA-52N-10E	800 000	5 800 000	2 500 000	9 450 000
Map 10a c+n	LAEA-52N-10E	1 350 000	6 650 000	2 500 000	9 450 000
Map 10a c+ns	LAEA-52N-10E	800 000	6 650 000	2 500 000	9 450 000

- Lambert Azimuthal Equal Area (LAEA), datum ETRS89, 52 N, 10 E, false easting: 4 321 000, false northing: 3 210 000.
- Lambert Azimuthal Equal Area (LAEA), datum ETRS89, 52 N, 65 E, false easting: 8 446 000, false northing: 3 210 000.
- Times, datum WGS84, 10 E, false easting: 0, false northing: 0.

7. EEA map layout and postscript map templates for reports

EEA has developed a set of specifications for maps and legends. This chapter focuses on maps produced for reports, but much of the information is also relevant for maps produced for the Web. The EEA and ETCs are expected to use the specifications frequently.

7.1. Standard size for postscript maps

The EEA has a standard layout for printed reports. Each page is built up of two columns of 82.4 mm and between the columns there is a 5 mm space (see Figure 7.1). The columns can be subdivided into two 38.7 mm columns with 5 mm space. Maps produced for reports as well as for factsheets should as far as possible follow these sizes (the factsheet maps often end up in a report).

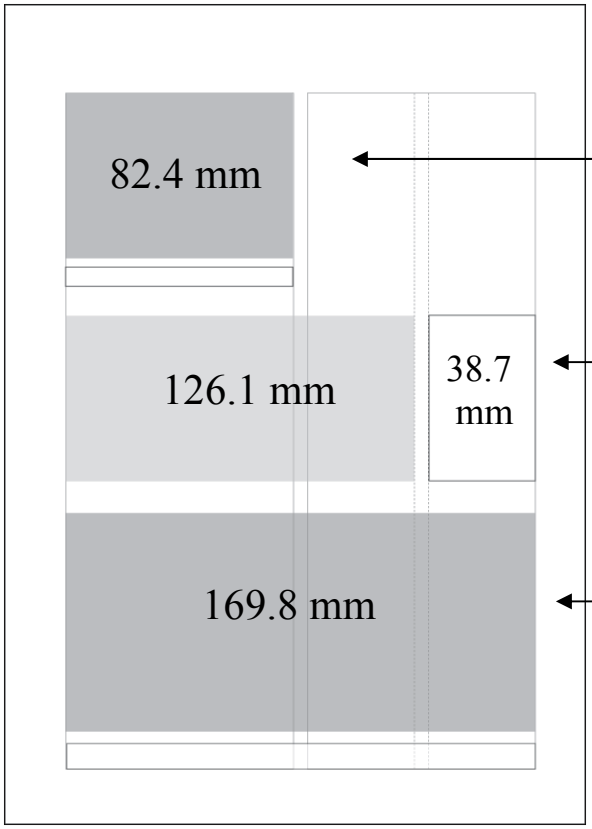


Figure 7.1: Dummy of page with the EEA layout standard.

Small map (for two adjecent), legend placed below

***Standard EEA map**, legend placed to the right*

Big map, legend placed below

- **The standard EEA map has a width of 126.1 mm, the legend at the right hand side has a width of 38.7 mm and there is 5 mm space between map and legend.**
- Accepted widths are:
  - 82.4 mm, where two small maps are presented beside each other, legend is placed below
  - 126.1 mm, **standard**, legend (38.7 mm) is placed to the right of the map
  - 169.8 mm, legend is placed below the map, same width as the map
- In a few cases, maps covering two pages are used. Contact IDS Publications for sizes.

7.2. Standard map projections

The map data and template files available from the EEA – both the GIS data and the postscript versions (Adobe Illustrator) – follow the prescribed projections. See Chapter 6 for details about the map extents, Chapter 8 for use of the template files and Chapter 2 for details about projections and reference systems.

7.3. Map extents for postscript maps and other final version maps

The EEA has defined a series of standard map extents as a basis for illustrations in reports and on the Web. Use of a set of standard map extents makes map making easier and more effective. Map data and template files are tailored for the specific purpose of getting harmonised outputs that fit the general EEA standard layout of reports.

Use these map extents, defined in detail in Chapter 6, when producing maps for reports and when presenting maps on the EEA Web pages. The series of map extents are defined according to **east–west** coverage. Each of the map types can have four different versions, depending on **north–south** extent. There are at present 10 map series with different east–west coverage, but only a couple of these are frequently used.

7.4. Scales of postscript maps

The EEA does not focus on certain scales for the maps presented in reports. The scaling of maps in order to provide one of the standard layout widths will probably not result in a rounded map scale. The EEA finds this of low importance for small-scale maps.

The map producer should make the map following the standard map extents outlined above. These can be presented in different scales.

The focus is on the size of the maps as planned in the report according to where they are to be used. Follow the standard for map width in reports (see Section 7.1).

7.5. Level of generalisation

Different generalisation of elements, e.g. administrative units, rivers and coastlines are available from the EEA:

- EEA GIS data (core data) are environmental data, and are not selected for mapping purposes. The data are primarily for producing environmental indicators;
- for most of the basic features, the GISCO reference database is delivered in three or four different levels of generalisation (scale 1, 3, 10 and 20 mill.). If a dataset is available at different scales, the data with the smallest scale should be used for maping;
- some datasets have a fixed generalisation. Datasets with polygons cut along the coast with a certain coastline will remain with this coastline;
- the EEA has put together a selection of generalised GIS datasets that are adapted to maps at small scales. ETCs and others producing maps on behalf of the EEA should use this selection. The data are labelled EEA map data. EEA's ArcGIS map templates (see Chapter 8) are also based on the use of these GIS data. The data are available from http://www.eionet.eu.int/gis.

7.6. Standard elements/features in maps

The maps which the EEA use in reports are usually very simplified. Therefore, the maps delivered to the EEA should contain few elements in the small-scale maps:

- few general elements/background features;
- few topic issues per map – usually one issue is enough. Maps covering more than one issue usually appear overloaded and the message in the map is lost.

The features delivered from the EEA to be used in map production are based on a level of generalisation comparable to 1:40 000 000 or even lower. Below is a table of proposed features for small scale maps covering Europe:

EEA map data	Filename	Size – width 82.4 mm	Size – width 126.1–169.8 mm
Background polygon	background		
Land (terrestrial) polygon	land	x	x
Countries polygon	countries	x	x
Sea surface	sea	x	x
NUTS-2 regions (restricted)	NUTS2		x
NUTS-3 regions (restricted)	NUTS3		x
Lake, large	lakelarge		x
Lake, medium	lakemedium		x
Lake, small	lakesmall		
River, major (Eurasia)	river		x
River, large	riverlarge		x
River, medium	rivermedium		x
Country boundaries, terrestrial	countryborder	x	x
Country boundaries, marine	marineborder		(x)
Arctic circle and tropics	parallels		x
Lat/long every 10°	latlong10	x	x
Lat/long every 5°	latlong5		
Coastline	coastline	x	x
Cities	cities		x
Capitals	capitals		x

The above table gives a generalised picture of the databases delivered from the EEA that could be used in the different map sizes. A mark is only a rough indication of the features that should be included in the map.

Note that symbol features (circles, squares, etc) in postscript files need to be 'outlined' before distributing the file (Outline Object command in Adobe Illustrator). Otherwise, the symbol fonts may be interpreted in a different way by other computers with different font settings. Attachments including the used fonts do not ensure the correct visualisation of the symbols in the postscript file.

7.7. Standard layer orders

The layers of the map as they come from the GIS system should be reflected as layers in the postscript file. Text should be placed in separate layers, according to the feature they are naming. Each layer name should be named in English. If all standard layers are in use, the following layer order is recommended.

Feature/map element	Layer order
Frame	1
Text	
Thematic text	2
Country names	3
Towns	4
Seas/lakes	5
Grid numbers	6
Points	
Thematic point data	7
Cities	8
Lines	
Thematic boundaries/line data	9
Coast/sea shoreline	10
Roads	11
Rail	12
Country boundaries	13
Rivers, medium	14
Rivers, large	15
Lake/shoreline	16
Gridnet (lat/long)	17
Polygons/areas	
Lake/river surface	18
Outside data coverage areas	20
Thematic areas	19
Land surface – outside data coverage	21
Sea surface	22
Countries	23

7.8. Colour and graphics definitions

The EEA has defined graphic layout (colour/line size) for selected features that are frequently used on maps. The specifications below are defined to fit the needs for use as originals in reports, factsheets and the Web.

7.8.1. Colour and graphics for background layers

The EEA distinguishes between polygon/area features, line features, point features and text.

Feature/map element	CMYK code	Colour	Size/pt	Font/line type/ fill type
Polygons/areas				
Land surface	0-5-25-0	Yellow		Fill/no line
Land surface – missing values/no data (*)	0-0-0-0	White		Fill/no line
Land surface – outside data coverage (*)	0-0-0-10	Grey		Fill/no line
Sea surface	20-5-0-0	Blue		Fill/no line
Lake/river surface	20-5-0-0	Blue		Fill/no line
Lines				
Coast/sea shoreline	50-20-0-0	Blue	0.3	Line
Rivers, large	50-20-0-0	Blue	0.3	Line
Rivers, medium	50-20-0-0	Blue	0.3	Line
Lake/shoreline	50-20-0-0	Blue	0.3	Line
Country boundaries	0-0-0-60	Grey	0.4	Line
Thematic boundaries	No line			No line
Frame	0-0-0-100	Black	0.5	Line
Gridnet (lat/long)	100-30-0-0	Blue	0.28	Line
Roads	0-100-100-0	Red	0.3	Line
Rail	0-0-0-100	Black	0.3	Line
Points				
Capitals	0-100-100-0	Red	6 pt	
Cities	0-0-0-100	Black	4 pt	
Text (**)				
Country names	0-0-0-100	Black		Verdana (***)
Towns	0-0-0-100	Black		Verdana (***)
Seas/lakes	0-0-0-60	Grey		Verdana (***)
Grid numbers	100-30-0-0	Blue	5.25 pt	Verdana (***)

(*) 'No data'-colour is always white and 'Outside data coverage'-colour is always grey in EEA products.
(**) Note that the EEA advises following Eurostat's practice for maps: the use of geographical names (especially seas, oceans, etc.) should be avoided.
(***) For text on Web maps, the recommended fonts are Verdana, Tahoma, Geneva or Arial.

For ArcGIS users: The colours defined above are used in the template files produced by the EEA (see Chapter 8). When adding new layers/datasets to a production, use of the predefined lyr files renders the defined colours, while use of the predefined shp files does not.

7.8.2. Colour and graphics for thematic information – use of common colour scales

General rules of map semiology (*The Semiology of Graphics*, Bertin, 1983), such as using a maximum of seven different colours or a maximum of five densities of grey, should be respected. The EEA recommends specific guidelines:

- When using statistical or ordinal division of data, the EEA has recommended colour scales (Figure 7.2). These may be used when arranging data according to relative value or other ordinal values. There is a sub-division according to basic colour and also the number of classes, 3, 4, 5, 6 or 7. The colour scales were set to facilitate photocopying, i.e. the resulting greyscales are meaningful. Please see http://www.eionet.eu.int/gis where files with the exact definitions of colours can be found (CMYK).
- Computer screens display colours differently compared with paper. The EEA's recommended colours for Web maps (RGB) are also located at http://www.eionet.eu.int/gis.
- When presenting distribution of areas (polygons), only colour the areas themselves. Avoid using a separate colour for the outline/boundary of each of the areas. Maps look cleaner without thematic boundary lines.

A B

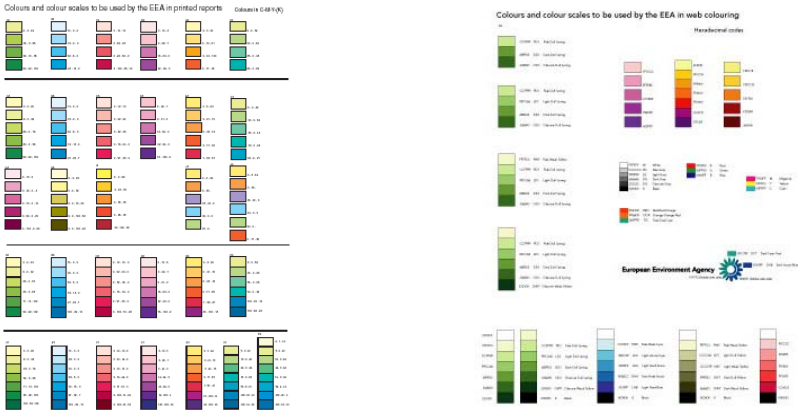

Colours and colour scales to be used by the EEA in printed reports
Colours and colour scales to be used by the EEA in web colouring
European Environment Agency

Figure 7.2: The EEA has guiding principles for colouring maps, based on some predefined colour scales, one for maps in reports (A) and one for Web presentations (B).

7.8.3. Colour systems – CMYK and RGB

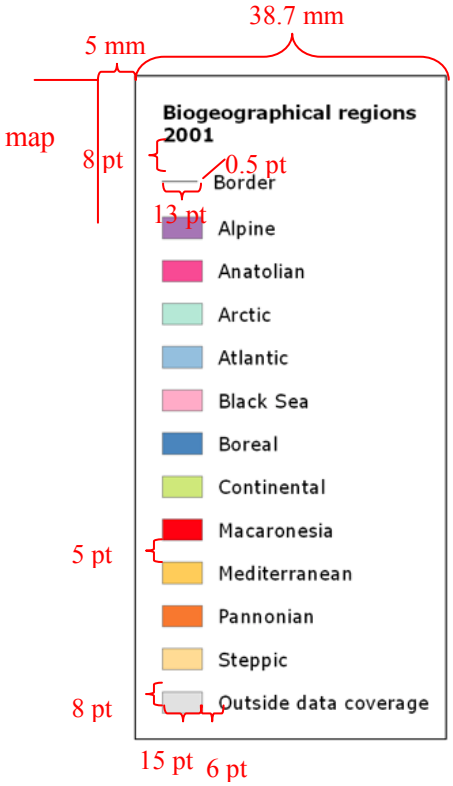
The colours are given in:

- CMYK for printing purposes: e.g. 5-100-55-12 or 0-12-10. The K value (black shade) is commonly omitted when equal to zero;
- RGB for screen purposes: RGB colours are given in hexadecimal code (often used in HTML), e.g. 66 2F 99 = 102 47 153.

The colours defined in the different systems may not be translated directly. CMYK has a limited colour spectrum compared with the other systems, especially in bright colours. If you have defined colours in RGB on the screen, the system may give you an incorrect colour as CMYK. This may also be the case in sending maps to a printer. In order for colour versions to be black&white copy-friendly and the message in the map to remain clear, special care has been given to the colour darkness in the EEA colour recommendations.

7.9. Legend

A map has a legend. The postscript file with the map should preferably also contain the legend with the layout to be used in the report. The legend is placed outside the map frame, normally to the right, with a 5 mm space between map and legend.



The legend standards are as follows:

Width: 38.7 mm is standard. See example to the right.

Fonts: Font type is Verdana both in ordinary text and in heading for printed material. For Web, recommended font types are Verdana, Tahoma, Geneva or Arial.

Font size: All text is 7 pt, headings in bold, category text is normal. Text colour is 100 % black.

Spacing between legend elements: In the example, the spacing between title and legend items is 8 pt. The spacing between label patches vertically is 5 pt.

Other:
- All text is left oriented;
- Where category text is longer than one line, the first line should be aligned with the label patch;
- Allow space between numbers and %: 7 %;
- Allow no space in year spans: 1900–2000;
- Interval dash is made using ALT+0150: –.

7.10. Text: translation implications

A number of the EEA reports are translated into the languages of the member countries. Text in maps and graphs are also translated and the text parts need to be easily accessible to the translation process. Therefore, the EEA makes the following recommendations:

- place text in separate layers;
- define text with the prescribed fonts and sizes. See Section 7.8 for font specifications;
- do not outline text;
- text that will be translated later should be black or grey (use only the K parameter in CMYK, see Section 7.8.3). Other text, such as numbers or 'ids' on locations, could have other colours. Note that the EEA advises following Eurostat's practice for maps, that the use of geographical names (especially seas, oceans, etc.) should be avoided.

7.11. Map templates in ArcGIS

The EEA has developed map template files (mxt files) for ArcGIS which work together with the selected data for map production (see Chapter 8). The export of maps to postscript format is done from GIS software. For producers using other software, the frame files for each map extent should be used together with the map data to create maps. The framefiles have the correct map extent and projection parameters.

7.12. Map templates in Adobe Illustrator format

In some cases, only simple maps are needed upon which objects can be marked. In such cases, it is not necessary to use a GIS tool. Instead, ready-made postscript base maps can be used. The EEA offers such maps at http://www.eionet.eu.int/gis: Adobe Illustrator template files with different map extents. The template files follow the specifications defined by the EEA.

When producing, delivering and storing postscript maps using this method, it will still be important for the EEA to receive and store GIS compatible data related to the presentation for documentation. ETCs and other producers of maps should provide the data files, e.g. thematic tables with lat/long values for point locations.

8. EEA map templates for GIS: tools for easy map making

8.1. Why use a predefined map template?

The EEA handles geographical data from many institutions and sources, and presents them as maps in different publications and on the Web. In 2001, the EEA started standardising the handling of this large body of data, and also started work on simplifying the production of maps. Map templates are one of several developments in this respect, and are now being used by the EEA and its partners. The templates are available at http://www.eea.eu.int/gis.

Map templates are developed for small-scale standard map presentations in printed reports and Web applications. The use of templates will simplify map production as map extents, map projections, background features (e.g. country boundaries, lakes, rivers) and colour schemes are predefined.

- **Whenever possible, the use of map templates is strongly recommended.**

Maps presented in reports and on the Web will appear harmonious and ease the final layout process. In future, it will be possible to reuse and mix data from different productions. Additionally, individual users save time and effort as there is no need to reproduce manually common parts of the maps.

8.2. Available GIS template files

The EEA has developed GIS template files for all map extents, identical to the extents presented in Chapter 6.

The templates cover smaller or larger areas of Europe up to the Urals, predefined for use in small-scale maps ranging from 1:70 000 000 to 1:1 000 000. Some templates, as described in Chapter 6, cover wider areas.

There is one template file for each map extent. This means that there are several templates for each of the map series as each series can have up to four different versions, concerning north–south coverage. Below is an example for map series 2:

Map 2	**EEA area: EU-25 + EFTA + CC-3**	Template filename
	Core	map_2c.*
	Core + north extension	map_2c_n.*
	Core + south extension	map_2c_s.*
	Core + north and south extensions	map_2c_ns.*

8.3. ArcGIS template files and using other software

The European Commission has decided to use ESRI products in their services and the EEA follows this recommendation. The ArcGIS map template files (.mxt) are made with the use of lyr-files that define colour and symbol definitions. However, users of other GIS software may use the standard EEA map data, the map extent frames (all in shape format) and the layout definitions in Chapter 7.

8.4. Standard map data for map templates

The templates contain a set of standard data layers, being commonly used background layers needed in visualisation. The following data layers are available.

EEA map data
capitals
cities
coastline
latlong10
latlong5
parallels
countryborder
marineborder
river
riverlarge
rivermedium
lakelarge
lakemedium
lakesmall
NUTS2 (*)
NUTS3 (*)
sea
countries
land
background

(*) NUTS data (statistical regions in Europe, see http://europa.eu.int/comm/eurostat/ramon/nuts/home_regions_en.html) are only available upon request and only to partners contracted directly with the EEA.

Data layers for templates are simplified for exclusive use on small-scale maps in reports or on the Web. The features delivered from the EEA to be used in map production are based on a level of generalisation in the databases comparable to a scale of 1:40 000 000 or even lower (see Section 7.6). Accordingly, maps based on these data are not suitable for reproduction in magnified versions, i.e. posters.

Most data layers have been modified and generalised from more detailed data to suit the aims of the templates. Examples of modification are generalising lines, dissolving polygons, removing small polygons and reclassifying code lists. The source of the map data and the procedures for modification are defined in metadata attached to the shape files.

8.5. Quick guide to using ArcGIS mxt template files

(1) Download the relevant template files (.mxt) from http://www.eionet.eu.int/gis. In ArcCatalog (or other file manager), navigate to C:\Arcgis\Arcexe*xx*\Bin\Templates and create a new folder called, for example, EEA templates. Paste the downloaded mxt files into the new folder.

(2) Download the EEA map data from the same location as in (1) to a folder on your computer or network.

(3) Open ArcGIS.

(4) If you get the dialog 'Start using ArcGIS with', tick 'A template'. If you do not get the dialog box, go to File > New.

(5) In the 'New' dialog, choose a suitable template from the 'EEA templates' tab. Make sure that 'Create New Document' is ticked in the lower left corner.

(6) The first time you open a template, all data layer names in the 'Table of Contents' appear grey and with a red exclamation mark. You have to re-establish the connection between the template and the data layers. Right-click on one of the greyed data layers, go to Data > Set data source, browse to the same data layer in the folder where you placed the data in step (2) and click 'OK'. As all data layers are located in the same folder, all layers in the template should now be connected. Note that a graticule with lat/long numbering is defined as graphics from Data Frame Properties > Grid tab.

(7) Go to File > Add data and browse to find your own data layers. Turn off unnecessary data layers that came with the map template.

(8) Modify the legend in agreement with Section 7.9.

(9) Save your map: File > Save. Make sure that the file type is mxd (map document). (This is the default option.)

(10) Export to postscript format (eps or other) is often required. Go to File > Export and, in the export dialog, choose format (.eps). Resolution of the output is set in Options; 300 dpi is usually sufficient in vector maps and 600 dpi in maps with raster data. It is recommended to examine the output file in Adobe or other image editing software to verify that the resulting map is satisfactory.

Note: If you regret your choice of map template while working with your map, you can change the template. On the Layout Toolbar (you must be in Layout View), click the 'Change layout' button. You will then be able to choose from the available map templates.

8.6. Predefined map extents and standard map data for ArcView 3.x and other software

For users of other GIS software or earlier versions of ArcGIS, it is recommended to use the frame files (shape format) by adding them manually to the GIS map projects. The frame files are correctly projected map frame polygons defined using the corner coordinates of Section 6.4. The map frame polygons correspond with the ArcGIS templates of the same name. The EEA standard map data (also shape format) can be added manually to other GIS software too, but the predefined colours, line thickness, etc would have to be redefined in agreement with Chapter 7.

Map name = template name	File name for the map frame
Map 1c	Frame1c
Map 1 c+s	Frame1c_s
Map 1 c+n	Frame1c_n
Map 1 c+ns	Frame1c_ns
Map 2 c	Frame2c
Map 2 c+s	Frame2c_s
Map 2 c+n	Frame2c_n
Map 2 c+ns	Frame2c_ns
Map 3 c	Frame3c
Map 3 c+s	Frame3c_s
Map 3 c+n	Frame3c_n
Map 3 c+ns	Frame3c_ns
Map 4 c	Frame4c
Map 4 c+s	Frame4c_s
Map 4 c+n	Frame4c_n
Map 4 c+ns	Frame4c_ns
Map 5	Frame5
Map 6	Frame6
Map 7	Frame7
Map 8	Frame8
Map 8c+s	Frame8c_s
Map 9a	Frame9a
Map 9b	Frame9b
Map 10 c	Frame10c
Map 10 c+s	Frame10c_s
Map 10 c+n	Frame10c_n
Map 10 c+ns	Frame10c_ns

The frame files are available from http://www.eionet.eu.int/gis.

9. Metadata for geographical data and maps

9.1. Requirements on GIS and map deliverables

Metadata (information about a data file/dataset) should accompany any geographically related deliverable to the EEA, including tabular data, GIS data and postscript data.

The EEA has developed specifications, guidelines and tools for handling metadata. Data producers are responsible for delivering true and well-formed metadata according to specifications. The EEA is responsible for validating received metadata as well as the main data files, and for making the metadata and data available (if conditions allow). End products are published through the EEA dataservice: http://dataservice.eea.eu.int/dataservice.

The following guidelines and tools for dealing with metadata are relevant for the EEA, the ETCs, national institutions and other external partners delivering geographical data (geodata) to the EEA.

9.2. EEA standard for metadata

The EEA has developed a metadata standard for geodata. The standard – termed the European Environment Agency Metadata Standard for Geographic Information (EEA-MSGI) – is a profile of the ISO19115 standard for geographical metadata. EEA-MSGI is defined as a set of metadata for discovery and quick understanding of geographical data.

Some of the main aspects covered in a metadataset are: name of data, description of data, coordinate reference system, source and methodology – including version of specification on which the compilation is based, responsible party, ownership, and user rights.

EEA-MSGI is designed to meet future needs and demands for inter-operability of metadata. Metadata will become a key component in the coming EEA spatial data infrastructure (EEA-SDI), the node linking the EEA to other European infrastructures such as Inspire (Infrastructure for spatial information in Europe) and the broader EEIS (European environment information system).

9.3. Different metadata requirements for different kinds of geodata

The EEA splits geographically related deliverables into two groups (see Figure 9.1):

- original geodata, e.g. tables, geodatasets and geodatabases (GIS data)
- compiled geodata, usually maps.

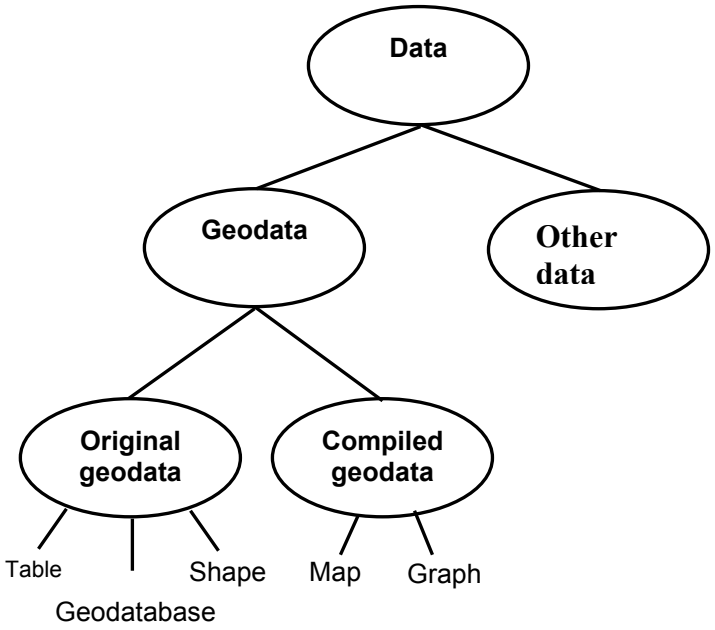


Figure 9.1: Different kinds of geodata, original geodata and maps

9.3.1. Metadata for original geodata (tables, geodatasets, geodatabases)

Original geodata are stored in formats commonly known as GIS data, e.g. shape file, Arc Coverage, geodatabase, SDE database, geotiff file, imagine-file or vpf, or other files which can contain, for example, point information such as XLS, dBASE file, access database, or text files.

A table is considered geodata if it has a spatial reference (attribute) or, through other table(s), can acquire a spatial reference, e.g. place name or shape.

Original geodata should always use the EEA-MSGI.

9.3.2. Metadata for compiled geodata (maps and graphs)

Compiled geodata are stored in formats such as postscript files or ESRI map document (mxd) files.

Compiled geodata should use the EEA metadata form for maps, see http://www.eionet.eu.int/gis.

9.4. Using EEA Metadata Editor for ArcCatalog

Using the ArcCatalog data explorer in the ArcView 8/9, ArcEditor 8/9 or ArcInfo 8/9 software packages, you can use the EEA Metadata Editor, designed specifically for EEA-MSGI. The editor provides an easy way to edit and visualise metadata.

9.4.1. Installing editor

You can find an EEA Metadata Editor installation zip file at http://www.eionet.eu.int/gis. Follow the instructions in the installation manual.

9.4.2. Using editor

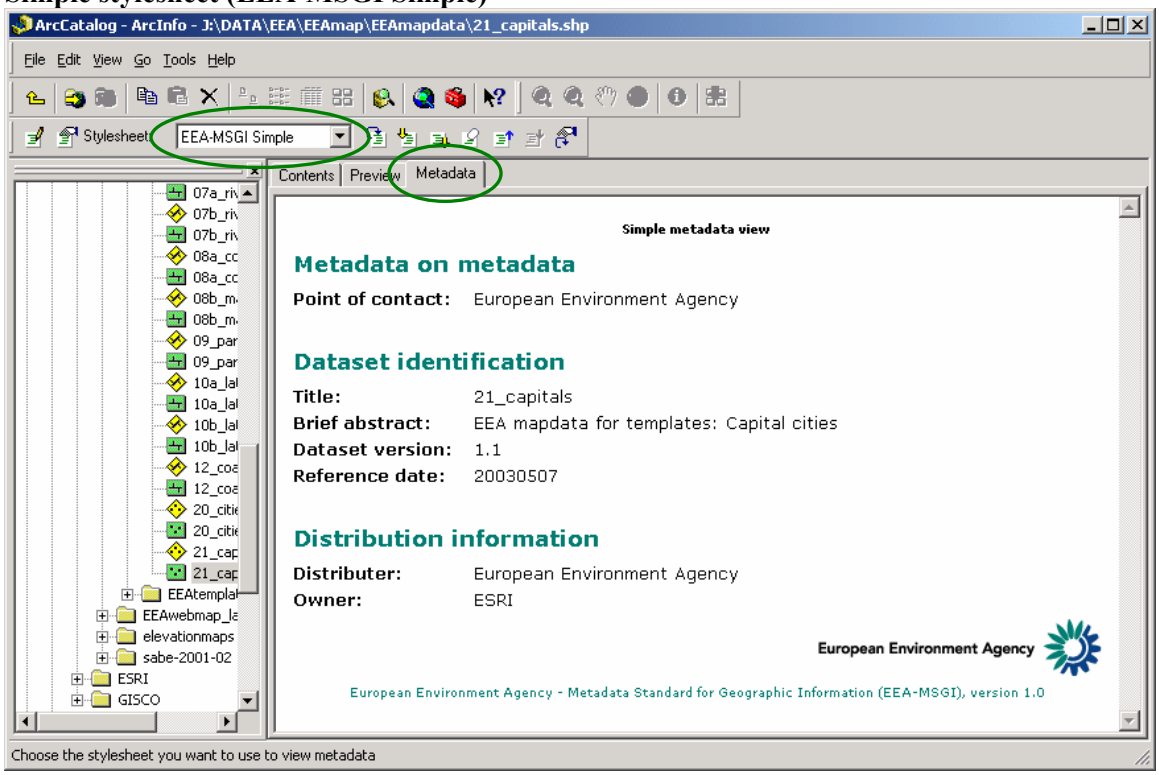
When using ArcCatalog with the EEA Metadata Editor installed, you can view, browse and edit metadata according to ISO19115 and EEA-MSGI. The editor is used the same way as the editors supplied by ESRI. Please consult the ArcCatalog user manual for more information about metadata editors.

The editor works on any file format accepted by ArcCatalog, including geodatabases.

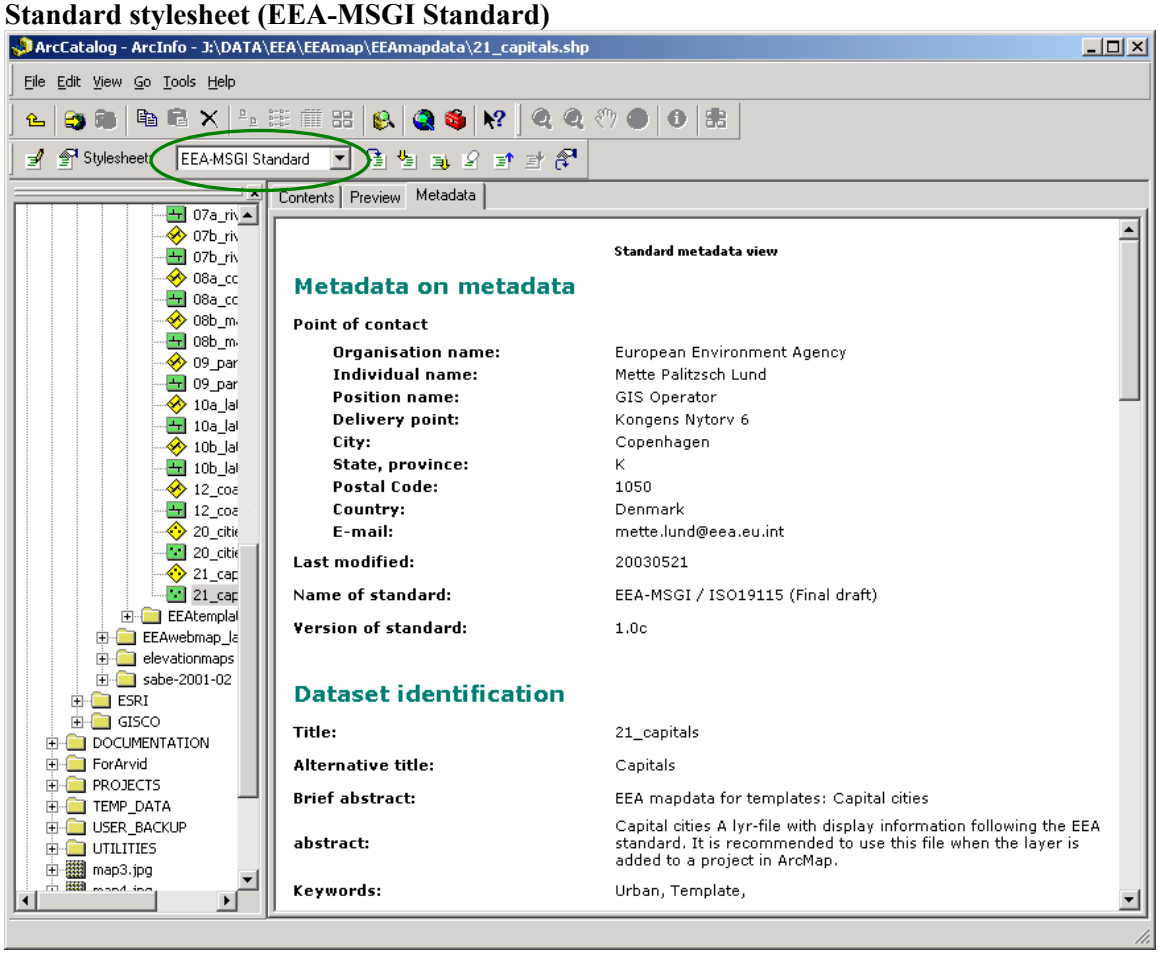
Viewing metadata

The editor provides two new metadata stylesheets (metadata views): a stylesheet for identifying a dataset called **EEA-MSGI Simple**, and a stylesheet for viewing all EEA-MSGI metadata information called **EEA-MSGI Standard**. Change the view of metadata in the metadata toolbar, which appears when the metadata tab is selected.

Simple stylesheet (EEA-MSGI Simple)



Standard stylesheet (EEA-MSGI Standard)



Editing metadata

To add or edit metadata to a dataset: select the dataset; click metadata tab; press the Metadata Edit button.

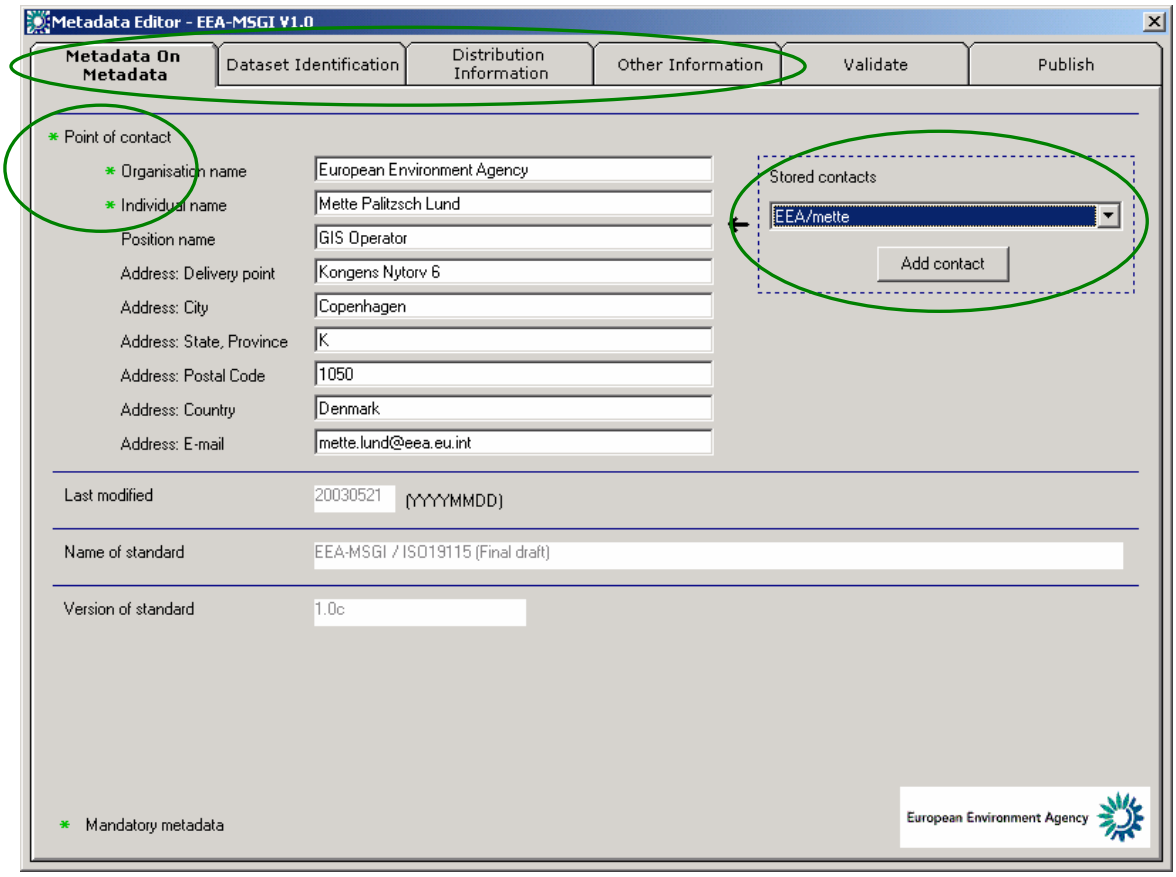
The editor splits metadata into four groups, *Metadata on Metadata*, *Data Identification*, *Distribution Information* and *Other Information*. Navigate between these groups using the tab page.

Metadata information marked with a green star (*) is mandatory.

The editor uses a database for storing often used addresses or contacts. You can edit this database if you have Access installed on your computer.

Other metadata elements such as file format and geographic reference system are automatically synchronised with the metadata.

See the EEA Metadata Editor user manual for further information (http://www.eionet.eu.int/gis).



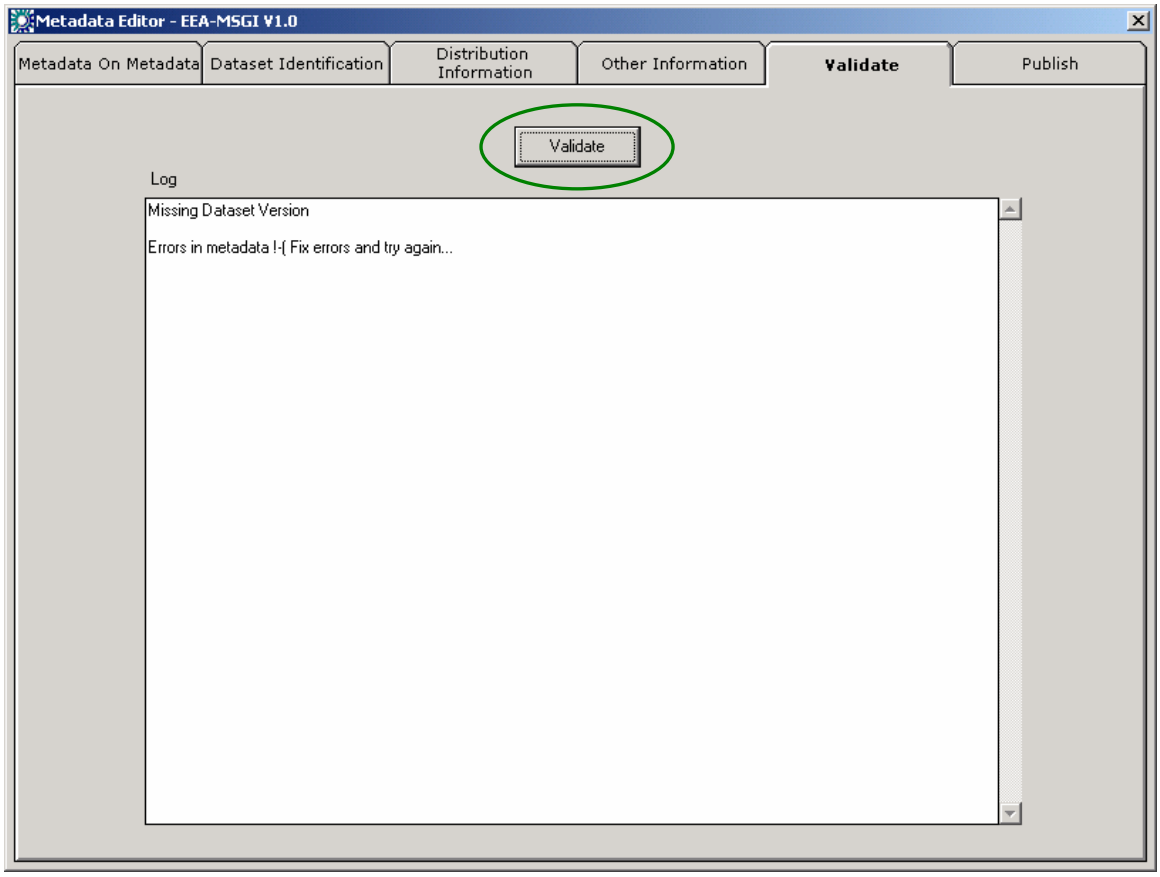
Validating metadata

Before submitting metadata with a dataset, make sure you have provided all the metadata needed.

This is done in two steps:

(1) Select the *Validate* tab. Press *Validate* and a validation log tells you which metadata are missing or wrongly formatted. If an error is listed in the log, fix the error and try again.
(2) When the validation is happy ☺, you can close the editor and the metadata will automatically be stored correctly. Select the EEA-MSGI Standard stylesheet and check that you have remembered all the textual information needed to describe the dataset.

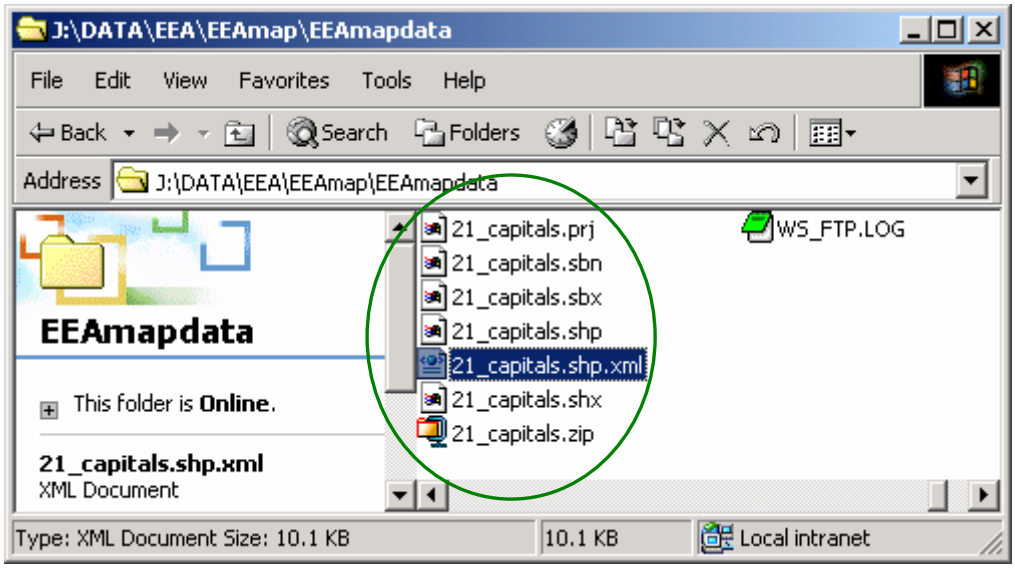
The validation tool validates other metadata elements not present in the editor, such as file format and geographic reference system metadata. These elements are synchronised automatically.



9.4.3. Submitting metadata

To submit metadata with a dataset, you have to know where the metadata is stored.

When a dataset is submitted to the EEA, such as shape files, dbf files or coverage, the metadata are stored in XML files. When submitting datasets stored as files, remember to include the XML file as well as the projection file (*.prj) in the delivery zip file.



When submitting a database or geodatabase, metadata information is stored inside the database. Before submitting a database, please contact EEA GIS operations using the web interface at http://www.eea.eu.int/help/infocentre/enquiries.

9.5. Using EEA spatial data metadata information form

When submitting original geodata not using the EEA Metadata Editor, the EEA spatial data metadata information form should be used. It is a Word document and the latest version can be found at http://www.eionet.eu.int/gis. You need to fill in the metadata from Word and validate entries manually.

9.5.1. Mandatory metadata

Mandatory metadata elements are marked with a green star (*).

9.5.2. Submitting form

Add the completed form document to your dataset delivery file package. Compress the package as a zip file before submitting to the EEA.

When the EEA receives the form, it will be validated and converted to an ISO19115 XML.

9.6. Using EEA metadata form for maps

Maps and graphs can be stored as postscript, images or application project files.

Find a link to the latest version of the EEA metadata form for maps at http://www.eionet.eu.int/gis. The metadata elements are based on Dublin Core standards.

9.6.1. Submitting form

Add the completed form document to your dataset delivery file package. Compress the package as a zip file before submitting to the EEA.